

# HISTORY of Physics

## NEWSLETTER

From the Chair

## Report From The Chair

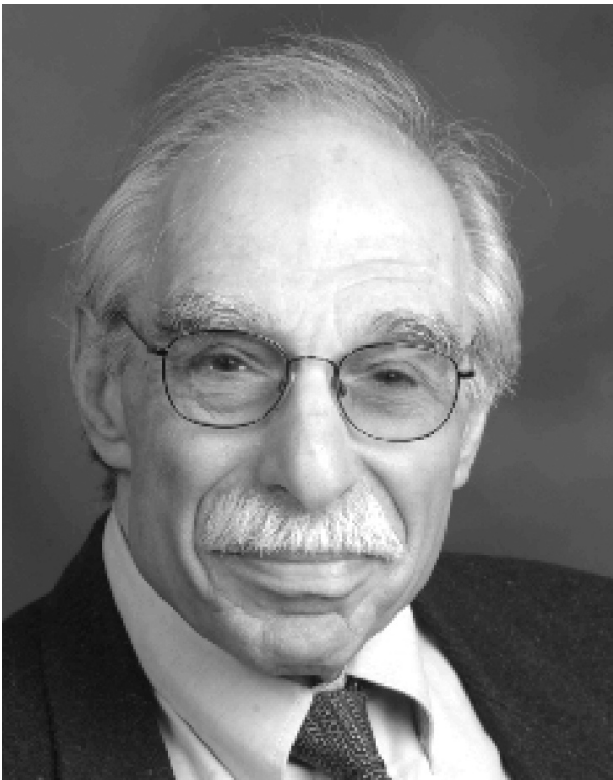
By Nina Byers, Forum Chair

Stephen S. Brush, one of our illustrious past officers, wrote an interesting and thought-provoking article entitled "Scientists as Historians" [Osiris, 10: 215-31 (1995)] which was very helpful to me when I first began to do research and writing on history of physics. He remarks that there is a distinction one can make between history of physics and physicists' history. Though the distinction is subtle and somewhat arguable, I find it a useful way of classifying scholarship. Simply put (no doubt an oversimplification) the distinction is that history of physics tends to place developments in physics in the social environment (sociological, political, economic, historical, etc.) in which they took place, while physicists' history tends to focus more narrowly on physics advances and how they occurred. Both are fields of study to which our members can make useful contributions.

The era we have lived through has been one of great discoveries and advances in physics. Many APS members have been, and perhaps still are, active participants, and have historical data they can share with other interested parties. To

facilitate this we have sponsored FHP contributed paper sessions at April general meetings whenever a sufficient number of historical papers have been submitted, and would like to do so as well at the March meeting. We hope a good number of members will make such contributions. The length of FHP talks cannot be more than twenty minutes. We realize that for most of us writing historical papers is an unfamiliar and difficult occupation but we hope members will find a short talk possible. Abstracts in total are limited to ~ 200 words. To be published in the Bulletin the abstracts must now be submitted electronically. See <http://www.aps.org/meet/abstracts/>. Contributors may also submit abstracts on paper, either by mail or fax. However contributors who submit abstracts on paper will have only their titles and author list published in the Bulletin of The American Physical Society. The text of the abstracts will not appear either in print or online. We are advised that the electronic submission form for the March and April 2005 meetings will be available online at the end of September 2004. If you are submitting an abstract, please be sure to indicate it is in category 18.3 (history). We hope to have lively FHP contributed paper sessions in the March and April meetings.

Before going on to tell you about other new and exciting innovations the Forum is working on for 2005, I would like to add a caveat to what I have written above. Many of our colleagues have spanned the divide between what might be termed history of physics and physicists' history. Illustrious examples are



*Martin J. Klein, winner of first Pais Award in History of Physics*

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Gerald Holton, Peter Galison, Stephen Brush himself and many others. It does not seem useful to me to keep these two forms of scholarship separate. I have drawn attention to this interesting distinction in an effort to encourage members to share with us their thoughts on past history, even though they may feel they are not historians and cannot do so professionally. Personal recollections of physicists who have been involved in the many wonderful discoveries of the past century are, in my view, of interest and great value. The remarks I have made here may be controversial and, if so, I hope they will provoke discussion which may appear in future Newsletters.

As Chair of the Forum I am proud that FHP provides a number of venues for scholarship and discussion of historical issues. We not only will be sponsoring contributed paper sessions, we also will sponsor several invited speaker sessions in both the March and April meetings. For celebrations of the World Year of Physics

– the Einstein Year, the APS has suggested that, with their financial help, we provide invited speakers to regional APS meetings. (See Harry Lustig’s Treasurer’s Report for details. Please contact Chair-elect Bob Romer, chair of FHP Program Committee, for further information.) Our vice-Chair Virginia Trimble, together with the APS Topical Group in Gravitation (GGR), is creating a program of speakers who will be available for schools and other groups for 2005 - the World Year of Physics. See <http://www.physics2005.org/speakers>. Volunteers are being solicited for the list of speakers. As you will see on the website, schools and colleges around the country are invited to request a speaker. Details can be found at <http://www.phys.utb.edu/WYP-speakers/REQUESTS/howto.html>. The APS general fund is providing some funds to cover travel expenses for some speakers whose host institutions may not otherwise be able to support them.

Additional special plans for 2005 are the initiation of FHP ‘Named’ lectures in the March and April meetings and the

award of the Abraham Pais Prize. The first recipient of the Pais Prize will be Martin Klein, and he will present an associated lecture. In the April meeting a ‘Named’ lecture will be given in honor of Gertrud Scharff Goldhaber and in March there will be a Robert H. Dicke lecture. Donors have generously given financial support for these. Please see the Treasurer’s Report regarding this and a new development, the creation of a ‘Special Fund’ in the FHP account to receive donations earmarked for Forum use. Finally I would like to draw your attention to the report of John Rigden from the Historical Sites Committee in this Newsletter which inter alia tells us that “During the year 2005, the centennial of Einstein’s most creative year and the year being celebrated internationally as the World Year of Physics, the Historical Sites Committee will seek to name several sites for national recognition.” We expect that the Historical Sites Program will be a continuing activity for years to come which will enrich our nation’s appreciation of its past.

## HISTORY of Physics NEWSLETTER

The *Forum on History of Physics* of the American Physical Society. It is distributed free to all members of the Forum. The Forum also has reciprocal arrangements with the History of Science Society, Philosophy of Science Association, HOPOS. Nonmembers who wish to receive the Newsletter should make a donation to the Forum of \$5 per year (+ \$3 additional for airmail). Each 3 year volume consists of six issues

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## Editor’s Note

### Online vs. Paper

As with everyone else in our e-connected world we are confronted with the question of whether or not to continue sending our Newsletter to readers the old-fashioned way, that is, by paper. The alternative is to join the on-line revolution and offer it exclusively via the web, thereby saving considerable money. Fortunately we do not have to face this Hobson’s choice. Due to a generous, anonymous donation our paper mailing will continue, at least for the next several years. (See treasurer’s report). But please be advised, if you specifically request so, we will discontinue mailing the paper version to you. Please send an email to the Editor to this effect, if you would like to be taken off the paper mailing list. Of course the Newsletter is always available online at [www.aps.org/units/fhp/FHPnews](http://www.aps.org/units/fhp/FHPnews), in both pdf and html formats.

### Invitation to our Members

Please consider this to be a continuing invitation to all our members to use this venue as a platform for any of you whose personal memories and obser-

vations are of possible interest to our readers, and I would like you to consider this to be a standing invitation to send us for consideration whatever items you think might be worth presenting. The Editor would also appreciate being alerted to articles and books in the history of physics, personal and institutional histories, memoirs, and any other works in physics history that would be worth calling to our readers’ attention, as well as announcements of appropriate meetings and other such activities.

### FHP Homepage

We invite our readers to visit the FHP Homepage, where information concerning many FHP activities can be obtained. There you will find links to other history of science websites, details of committee memberships, all back issues of the FHP Newsletter, etc. Go to: [www.aps.org/units/fhp/index.cfm](http://www.aps.org/units/fhp/index.cfm)

### Corregidum

The volume number of the Spring 2004 issue of the Newsletter was incorrectly listed as Volume XI No.2. The correct listing is Volume IX No. 2.

## Call for Contributed Talks

In honor of the World Year of Physics, your Forum will host sessions of contributed talks at both the March (21-25, Los Angeles) and April (16-19, Tampa) meetings. This conveniently coincides with a decision by APS council to allow each member at each meeting to give a talk at a session of some forum as well as a

technical talk at a division or topical group session, without either being placed on the supplementary program. Please consider sharing your interests in history of physics by giving such a talk! For further details see Report from the Chair, above.

For March (only) there will be some travel support, probably \$500, available for one outstanding student, giving a

contributed talk, who will be designated the John Bardeen Student, thanks to a donation from his family. If you have (or are) such a student, when the abstract is ready, please also send it to vtrimble@uci.edu with a note that this is a candidate for the Bardeen title. The student selected by a subcommittee will be notified early in December.

# Forum News

## FIRST PAIS AWARD GRANTED: WINNER IS ANNOUNCED TO BE MARTIN J. KLEIN

Report by Roger H. Stuewer

Martin J. Klein, Eugene Higgins Professor Emeritus of History of Physics and Professor Emeritus of Physics at Yale University, is the winner of the 2005 APS/AIP Abraham Pais Award for the History of Physics "for his pioneering studies in the history of 19th and 20th-century physics, which embody the highest standards of scholarship and literary expression and have profoundly influenced generations of historians of physics." He will deliver his Pais Lecture at the APS meeting in Tampa, Florida, April 16-19, 2005. The talk is entitled "Physics, History, and the History of Physics".

Klein received his higher education in physics at Columbia University and MIT and was appointed to the faculty of the Case Institute of Technology in 1949. He spent a year as an NRC Fellow at the Dublin Institute of Advanced Studies in 1952-1953, received a Guggenheim Fellowship to study at the Lorentz Institute of Theoretical Physics of the University of Leiden in 1958-1959, and served as Acting Chairman of the Department of Physics at Case during 1966-1967. His research was principally on the theory of thin ferromagnetic films and on various theoretical problems in statistical mechanics.

Klein's research began to turn to the history of physics during his year in Leiden, when he published a two-part paper on Ehrenfest's contributions to the development of quantum statistics and edited Ehrenfest's *Collected Scientific Papers*. In 1962-1963 he published further papers on Ehrenfest's work and his penetrating studies of Planck and the beginnings of

quantum theory and of Einstein's first paper on quanta. During the following four years, he published several more papers on Planck's and Einstein's contributions to quantum theory, and Einstein's, Schrödinger's, Planck's, and Lorentz's letters on wave mechanics, which he translated into English. This distinguished body of historical work led to the award of a second Guggenheim Fellowship in 1967-1968 and to his appointment as Professor of the History of Physics at Yale University in the fall of 1967. Since then he has held a number of visiting appointments at other universities, lectured widely, and published a large number of further historical papers, as well as his magnificent biography of Ehrenfest and biographies of Ehrenfest, Einstein, and Gibbs for the *Dictionary of Scientific Biography*. In addition, he served as senior editor of four volumes of the *Collected Papers of Albert Einstein*, further enhancing his reputation as one of the most profound analysts of Einstein's life and work.

Klein is a Fellow of the AAAS and of the APS and has been elected to the Académie Internationale d'Histoire des Sciences, the National Academy of Sciences, and the American Academy of Arts and Sciences.

## PAIS AWARD FUND RAISING CONTINUES

Report by Harry Lustig

After three years of effort, the APS Award in the History of Physics, under the aegis of FHP and AIP's Center for History of Physics, is now firmly established. It has been named in honor of Abraham Pais, and the first winner has been chosen, as noted above.

The endowment of \$100,000 that is required to establish an Award has been reached and *mirabile dictu*, and, most fortuitously on the threshold of the

centenary celebration of Einstein's *annus mirabilis*, it has been exceeded. We now have \$140,000 in hand.

As soon as the Award Selection Committee, the FHP Executive Committee, and APS noted that achievement, there was a unanimous agreement and commitment to mount an effort to elevate the Pais Award to the Pais Prize. A prize, which carries a stipend of \$10,000 based on an endowment of \$200,000, is the highest scholarly distinction that the APS can confer. Most of the divisions of APS, which unite physicists in the traditional research disciplines, award such a prize. We believe that it is important for the recognition of the field of history of physics and of its practitioners that there be a Pais Prize.

Therefore, our fund-raising continues. We have some outstanding prospects for donations and a pledge from a foundation to contribute the last \$13,000. However, a substantial gap remains. Thus, both personal contributions and pledges, as well as "tips" about individuals who may be prospects for sizeable gifts, are very much welcome and needed. Please send the former, as well as inquiries on how to make a gift or pledge to

Darlene Logan, Director of Development, The American Physical Society, One Physics Ellipse College Park, MD 20740-3844, Phone (301)209-3224, Fax (301)209-0867; E-mail logan@aps.org. Send the latter to me or any other member of the committee. It consists of Benjamin Bederson (chair through 2004), Gloria Lubkin, Michael Riordan, Roger Stuewer, Spencer Weart, and Harry Lustig, Chair

## APS Forms Historical Sites Committee

Report by John S. Rigden

The designation of a site as "historical"

can attract attention. More importantly, however, a historical site can be the means of informing and educating the viewing public. With these ends in mind, Michael Riordan, in his capacity as chairman of the APS Forum on the History of Physics, established the Historic Sites Committee (HSC). Appointed to the committee were Gordon Baym, Sid Drell, Millie Dresselhaus, Gerald Holton, and John Rigden. Spencer Weart serves as an advisor to the committee. Rigden was named the chairman by the committee.

The charge, pending approval by the APS Executive Board to the HSC is to "examine policy issues and other questions regarding the implementation of a proposed American Physical Society project to select, signify and publicize noteworthy institutions and locations in the United States where major advances in physics occurred....The Committee may also serve as the selection committee charged with naming these sites if that option is later deemed desirable by the Executive Committee of the Forum on History of Physics, and it will keep the Executive Committee well informed of its recommendations."

We, members of the committee, believe the presence of strategically-placed plaques that identify sites of historical significance to physics will be an effective means to raise public awareness of physics. We also recognize that the initiative will

benefit physicists by increasing their own awareness of important past scientific advances, hence of the historic evolution of their profession.

Two categories of sites will be selected: the first category, (C1), consists of those sites with national/international significance to physics and its history; the second category, (C2), consists of sites with more local significance. The committee will select both C1 and C2 sites either from potential sites suggested by committee members or from those sites formally nominated by APS members. Both C1 and C2 sites will carry the imprimatur of the American Physical Society.

C1 sites can be focused on an individual(s) or an event such as the Michelson-Morley experiment in Cleveland, Henry Rowland's lab in Baltimore, Willard Gibbs at Yale, Benjamin Franklin in Philadelphia. Also, C1 sites can be a place (examples might be Lawrence Berkeley Laboratory, Jefferson Laboratory at Harvard, University of Chicago, MIT, Fermilab, SLAC, Bell Labs) where many important advances have been made by physicists of renown.

Before APS makes public a selected site, the committee will obtain the endorsement of those individuals historically connected to the event being celebrated and an agreement will be made with the local authority administering the selected site that enables the plaque to be mounted

at the site in a way that is readily accessible to public view. For C2 sites, nominations will be made largely by individuals at the local level familiar with events of physics-related interest. A standard nomination form will be posted on the Historic Sites (HS) web page along with a few selection criteria. From these nominations, the HSC members will select sites to be recognized. The HSC will keep the FHP Executive Committee informed about its activities.

Selection criteria are now being developed. In this process, we are guided by the experience of the National Register and groups, such as the Institute of Physics, that recognize sites of historical importance. Since we believe that local sites have a great potential for raising a community's awareness of physics, we shall adopt somewhat more liberal selection criteria for C2 sites. During the year 2005, the centennial of Einstein's most creative year and the year being celebrated internationally as the World Year of Physics, the Historical Sites WCommittee will seek to name several sites for national recognition.

Plaques will have a standard format. A ceremony will be held at the site when the plaque is unveiled.

After the APS Executive Board has approved the HSC initiative, an announcement will be made inviting nominations for site recognition.

# Call for Nominations

Report by Michael Riordan

This year the Forum's Nominating Committee, which I chair, faces a truly daunting task. In addition to convincing good candidates to run for Vice Chair and the Executive Committee positions that will come open, it must also find them for Treasurer and Forum Councilor. The latter will be vacated in 2006 by Gloria Lubkin, who has ably represented the Forum on the APS Council for two terms. Thus we need an unusually large number of good historians and physicists to come forward in the next few months and offer to take on these responsibilities.

The health and vitality of the Forum depend crucially on such people. Therefore I seek the help of the entire membership in

identifying these candidates in the coming months, when the Nominating Committee will be doing its work. Please forward your suggestions to me at my new email address, [mriordan@ucsc.edu](mailto:mriordan@ucsc.edu). And if you wish to run for office yourself, we would of course be delighted!

## FHP Officers 2004-2005

Chair: Nina Byers,  
Chair-Elect: Robert Romer,  
Vice Chair: Virginia Trimble  
Acting Secretary-Treasurer:  
Kenneth W. Ford

## Members at Large

Patrick McCray, Daniel Siegel, Noemie

Benczer-Koller, Michael Nauenberg, John Rigden, Roger H. Stuewer

## Ex Officio Members

Michael Riordan, Gloria B. Lubkin, Spencer R. Weart, Benjamin Bederson

## Committee Memberships

### Editorial Board and Publications Committees

Benjamin Bederson, Chair, William Evenson, Daniel Greenberger, John Rigden, Michael Riordan, Spencer Weart

### Fellowship Committee

Virginia Trimble, Chair, Gerald Holton, Robert Romer, Roger Stuewer

### **Nominating Committee**

Michael Riordan, Chair, Noemie Benczer-Koller, Gloria Lubkin, Daniel Segal, George Trilling

### **Program Committee**

Robert Romer, Chair, Nina Byers, Laurie Brown, Gerald Holton, Harry Lustig, Michael Nauenberg, John Rigden, Roger Stuewer, Virginia Trimble

### **(Pais) Award Committee**

Harry Lustig, Chair, Benjamin Bederson, Gloria Lubkin, Michael Riordan, Roger Stuewer, Spencer Weart

### **(Pais) Award Selection Committee**

Roger Stuewer, Chair, Allan D. Franklin, Lillian Hoddeson, Anne J. Kox, Spencer Weart

### **Membership Committee**

Harry Lustig, Chair, William Evenson, Patrick McCray, Michael Nauenberg, Daniel Siegel, Virginia Trimble

### **Historic Sites Committee**

John Rigden, Chair, Gordon Baym, Alan Chodos, Sidney Drell, Mildred Dresselhaus, Gerald Holton, Spencer Weart

# Meetings

## **INVITED PAPERS, MARCH AND APRIL APS MEETINGS.**

We present a short summary of the two invited paper sessions at the March APS meeting and the three such sessions at the April meeting. Several of these sessions were jointly sponsored by other APS units, as indicated. We thank all of the organizers of these sessions; they were well attended and received. Several summaries of talks are included; abstracts of most of the remaining talks can be obtained from the APS website by clicking on “meetings”.

## **March Meeting**

### **The History of Physics in Canada: Some Highlights.**

Harriet Brooks: Canada's First Woman Physicist *Geoffrey Rayner-Canham (Sir Wilfred Grenfell College, Memorial University)*

McLennan, Allen and Misener: Low temperature physics at Toronto in 1920-1936 and the discovery of superfluidity. *Allan Griffin (Department of Physics, University of Toronto)* *Boris P. Stoicheff (Department of Physics, University of Toronto)*

Brockhouse and others: Neutron Scattering and Condensed Matter Physics at Chalk River Labs *Eric Svensson (National Research Council Canada, Steacie Institute Neutron Program, Chalk River Laboratories, Stn. 18, Chalk River, ON, K0J 1J0 Canada)*

### **The History of Physics in Industrial Laboratories.**

*Jointly sponsored by FHP and FPS*

From X-Rays to MRI: Physics in GE *Roland W. Schmitt (Rensselaer Polytechnic*

*Institute) The Rise of Basic Research at the Bell Labs: Young Turks and Younger Turks* *Philip Anderson (Princeton University)* The History of Physics at IBM T.J. Watson Laboratories *Allen Fowler (IBM)* Physics at Microsoft Research *Jennifer Chayes (Microsoft)*

### **Monolayers and Multilayers:**

#### **Agnes Pockels and**

#### **Katharine Blodgett.**

*Jointly sponsored by FHP and CSWP*

Agnes Pockels: Life, Letters and Papers

*Christiane A. Helm (Institut für Physik, Ernst-Moritz-Arndt Universität, 17489*

*100 Years of Monolayers at the Air/Water Interface: Agnes Pockel's Scientific Legacy*

*Charles Knobler (Department of Chemistry and Biochemistry, University of California, Los Angeles, CA 90095-1569)*

Katharine B. Blodgett: Aunt, Friend and Physicist *Katharine Gebbie (National Institute of Standards and Technology)*

70 Years of Built-Up Films: Katharine Blodgett's Scientific Legacy *Daniel Schwartz (Department of Chemical and Biological Engineering, University of Colorado at Boulder)*

## **April Meeting**

### **The Discovery of Black Holes.**

*Jointly sponsored by DAP and FHP—report by Virginia Trimble*

Observers' black holes have sizes comparable with their Schwarzschild radii,  $R = 2GM/c^2$ , are too massive to be neutron stars, and swallow things. These undoubtedly exist in two, three, or more contexts concurred the five speakers at “The Discovery of Black Holes” session (Drs. Omer

Blaes on active galaxies, Fulvio Melia on the Milky Way, Jeff McClintock on X-ray binaries, Cole Miller on undetected, primordial, intermediate mass, and other obscure black holes, and Virginia Trimble, a last minute substitute for Werner Israel on history and theory of the topic.)

The consensus contexts are galactic centers and binary stars. Black holes of millions to billions of solar masses, accreting from their surroundings, have long been accepted as the best-bet power sources for quasars and other active galaxies. A more recent discovery is that nearly all galaxies have such black holes, with masses typically 0.1% of their masses in old (bulge, spheroid) stars. The non-active ones are hungry rather than hole-less, and progress on the details of how the accretion energy is transformed into magnetic fields and relativistic particles has been painfully slow in the 40 years since the basic model was put forward (Blaes).

Our own Milky Way is only mildly active, with a compact central radio source known for decades as Sgr A\* and its X-ray and infrared counterparts found more recently (indeed the infrared one in the last few months). It is fairly hungry at best, because there isn't much around for it to accrete, but it is in fact even fainter than the gas supply would suggest, meaning that, one way or another, energy goes down the tubes. There are, of course, competing mechanisms (Melia). Compact sources of X-rays in our own and other nearby galaxies are generally associated with close orbiting star pairs. Radial velocity curves of the star you see optically can then be used to estimate the mass of the star you don't see, and a dozen or more of these now fall unambiguously in the black hole X-ray binary category, with masses of 6 - 16 solar masses and some evidence for distortions of the surrounding space-time,

swallowing, etc. Theorists are quite happy to produce these in requisite numbers (McClintock).

Among the other sorts of possible black holes are the very small, the very large, and the very intermediate. Mini (primordial) BHs are either not very common in the universe, do not emit Hawking-Bekenstein radiation in the expected fashion, or both. Very large ones floating alone through space would gravitationally lens their backgrounds and are also not a major part of the cosmic dark matter.

The newest category contains the intermediate mass black holes of 100 - 1000 solar masses, bigger than the XRB ones but smaller than the galactic nuclei citizens. These are the most straightforward explanation of compact X-ray sources, mostly in other nearby galaxies with active star formation, that have energy outputs which must otherwise be greatly in excess of the Eddington limit or strongly beamed. There is also some dynamical evidence for these at the centers of a few star clusters, and theorists (including Miller) are hard at work producing them. A theorist's black hole has strange things inside, and of the existence of these we are far less certain. Possibilities include balls of superstring, time and space exchanging their identities, true singularities, and entrances to time machines. A good many theoretical issues (white holes, Einstein-Rosen bridges, implications of alternative theories of gravity...) remain, but the most exciting unanswered question is whether naked singularities, without a censoring horizon, can form in the real world (Trimble substituted as Chair)

#### **Science Advising, Jointly sponsored by FHP and Forum on Physics and Society**

D. Allan Bromley, Yale University, "The President's Scientists: Reminiscences of a White House Science Advisor"

Gregg Herken, University of California, "Presidential Science Advising from Roosevelt to Reagan"

Wolfgang Panofsky, SLAC, "Science Advising Successes and Failures"

Jack H. Gibbons, "On Advising Congress and the President" *See article.*

Joel Primack, UC Santa Cruz, "The Congressional Science Fellow Program and Other Efforts to Help Congress and the Public Make Wiser Decisions on Technology"

#### **Mössbauer Spectroscopy: Various Historical Perspectives.**

*Report by Catherine Westfall Argonne National Laboratory*

This session, which was organized by Catherine Westfall and chaired by Gopal Shenoy, started with a brief introduction by Shenoy. As Shenoy explained, starting in the mid-1950s, Rudolf Mössbauer, a German graduate student, conducted experiments that demonstrated in the next three years that an atomic nucleus in a crystal does not recoil when it emits a gamma ray and provides the entire emitted energy to the gamma ray. Mössbauer spectroscopy subsequently became a powerful tool in a variety of fields, including nuclear and condensed matter physics. A current—and exotic – application of Mössbauer spectroscopy is the pair of palm-sized spectrometers on the Mars Explorations Rovers which began analyzing rock samples in Spring, 2004.

John Schiffer then focused on the period right after Mössbauer published his discovery in 1958/59. Although at first few believed his Mössbauer's result was real, it was confirmed in August 1959 and quickly understood in analogy with the recoil-free scattering of x-rays essential to x-ray diffraction, known since the 1920s. A very favorable case was quickly discovered in  $^{57}\text{Fe}$ . The next few months were exciting and eventful as the implications of the discovery were pursued. As many as five Letters were published in a single issue of Physical Review Letters, with a turn around time of 2-3 weeks between submission and publication. In the first few months of 1960 a variety of new physics topics were explored, from hyperfine fields and chemical shifts to relativistic effects. Particularly interesting was the description of the gravitational red shift experiments Ted Cranshaw and Schiffer did with others at Harwell that confirmed the expected effect at the 10% level and story of the competition with Robert Pound and Glen Rebka.

The next part of the story was taken up by Hans Frauenfelder, who organized the first international Mössbauer spectroscopy conference in June 1960 at a conference center, "Allerton House" operated by the University of Illinois. The rush of exciting new data meant that Frauenfelder felt compelled to organize the conference in a mere five weeks and to proceed with a leg broken in a skiing accident. Despite

the late notice, everyone came. The 90-member list of participants included three who were – or were to become – Nobel laureates (Madame C. S. Wu and John Bardeen, in addition to Mössbauer himself, who by then was at Caltech.) The sessions went from 8:30 am to past midnight, and controversies raged, for example, on the interpretation of the gravitation red shift experiments. The conference proceedings, which was published in 1962, served as an important reference for work in the field. The early excitement had lasting results: the conference ended up starting a series of conferences that continue in 2004.

Catherine Westfall next gave a historical overview. Focusing in particular on Mössbauer spectroscopy at Argonne, she explored the role played by large multidisciplinary U.S. national laboratories – the so-called "Homes of Big Science" in the production of research. She first examined two smaller-scale efforts: a program led by nuclear physicists in the early 1960s that explored xenon compounds and a program led by condensed matter physicists in the mid-1960s through the 1970s that studied transuranics. She compared this work with research performed since the 1990s at the Mössbauer beamline at Argonne's Advanced Photon Source, the largest operating U.S. accelerator. She judged the APS work to be surprisingly similar to the earlier work, concluding that it represented a different kind of little science rather than Big Science. Further she noted that large laboratories provide "sites of collaboration," exotic materials, and specialized equipment that facilitate novel research at a variety of scales.

Hollis Wickman finished up the session with a talk that discussed what he sees as the closing chapter for "new physics" inherent in the Mössbauer effect – work from 1964 to 1970 focused on condensed matter phenomena that affect the various spectroscopic parameters measured: isomer shift, recoil free fraction, magnetic hyperfine interaction, and the quadrupole interaction. He noted that wrapping up the dynamic phenomena included essentially all of the earlier static effect physics as well. Wickman also noted that it took about 12 years to "mine" all the new spectroscopic physics from the Mössbauer effect. This was remarkably fast, given the primitive state of computers at the time. As a calibration for the "physics problems,"

high temperature superconductivity was discovered in 1987, but is still a mystery in many important respects.

## April APS Meeting contributed papers session

The contributed papers session at the April APS meeting, held on Monday May 3, was a smashing success, taking place before a packed room from beginning to end. Six papers were presented. It was Chaired by Bob Romer.

The first paper was by **Harry Lustig, [APS Treasurer Emeritus] Professor of Physics Emeritus at the City College of New York.** The title was “**Germany’s failure to achieve an atomic bomb in World War II: bad science, good intentions or neither?**” Lustig has been exploring this question [intensively] for the past two years. He has traveled to Munich and Berlin, and has examined many archived documents at their original sources. He showed some copies of several of these documents during his talk. While he was not ready to draw a definitive conclusion, he opined that in all likelihood the answer was “neither”. There was a remarkable lack of priority attached to the German atomic bomb project by the government. Lustig pointed out the enormously larger effort exerted on rocket and missile research, compared to atomic weapons research—an observation already made by Goudsmit in his ALSOS report. Unlike Paul Lawrence Rose in his book “Heisenberg and the Nazi Atomic Bomb Project, 1939-1946 – A Study in German Culture”, Lustig did not belittle the scientific progress made by the Germans, including Heisenberg, who, perhaps after some initial fumbling, certainly did understand the difference between a slow neutron “runaway reactor” used as a bomb (which is not possible), and a critical uranium 235 assembly relying on the generation of fast neutrons in a chain reaction. Lustig certainly did not endorse the claim, by Thomas Powers, in his book “Heisenberg’s War” that Heisenberg and perhaps other leading German scientists held back on their research because of ethical scruples, but neither did Lustig attribute the German failure to their scientific inadequacy, which did not exist. [On the contrary Heisenberg and others did understand very well the nature of a fast neutron change reaction, as well as the related slow neutron reactions resulting from a reactor pile.) Rather, he believes

on the basis of his investigations, that the failure to develop the bomb was attributable, as he states in his Abstract, to “the minuscule resources devoted to the project, the lack of German industrial capacity, the poorly organized and decentralized organization of the research, and the modus operandi of researchers, including Heisenberg, of simultaneously pursuing other interests”. By the end of the War, not one gram of U 235 had been separated]

The second paper was presented by **Elisabeth M Sopka, affiliated with FOCAS—Four Corners Analytic Sciences, entitled Bonebrake Theological Seminary—Most Secret A-Bomb Project Site.** Dr. Sopka is the daughter of the late Dr. John J. Sopka, whose work on the development of the neutron source for the “Fat Man” implosion bomb she described in vivid detail. At the talk she was accompanied by her mother, Dr. J. Sopka’s widow. A thorough summary of Elisabeth’s talk prepared by her is given in an accompanying article (**WHO KNEW I**), to which we refer the reader.

The third paper was given by **Benjamin Bederson, New York University, Early electron-atom scattering and its influence in the development of quantum mechanics.** Bederson discussed the important role played by early experiments in electron-atom collision studies at low electron energies in the development of quantum mechanics. The first such experiment was a cross section absorption study of low energy electrons by several rare gases in 1903 by Philip Lenard. This important experiment, while more qualitative than quantitative, revealed two important phenomena that in hindsight were to reveal, first, that atoms had internal structure—not hard spheres—whose absorption probability (i.e., “cross sections”) increased with decreasing energy, and second, that rather than increasing without limit as energy decreased, reached a finite value in the limit of zero energy, an indication (also in hindsight) of electron diffraction. This experiment, not as well known as the contemporary Franck-Hertz experiment, which revealed the important fact that static atomic energy levels were also important in understanding dynamic atomic effect, were the earliest direct evidence that stationary states (as Bohr stated) were the very same states that participated in dynamic, as well as static, phenomena in atoms. As an aside, later Lenard, along

with Johannes Stark, evolved into Adolph Hitler’s favorite physicists. Both turned into virulent anti-Semites and (in the author’s opinion) helped form the Nazi’s poor opinion of “Jewish physics” and, by extension, nuclear physics, perhaps helping to explain their assignment of low priority to atomic weapons (see the Lustig paper). Bederson went on to discuss the most important experiments of Ramsauer (and Townsend) who discovered that heavy rare gas cross sections went through deep minima at one or two electron volts, a phenomena which could not easily be described by classical scattering theory, if at all. While Bohr and other pioneers in quantum mechanics pondered the matter deeply, it remained for several “bread and butter” physicists, namely Faxen, Hotmark, Morse, and Allis, to achieve quantitative agreement between calculations and experiment, using the old scattering formalism of Lord Rayleigh, in the 1870s. He had solved the problem of scattering of a plane sound wave from a sphere, using expansions in spherical harmonics and Legendre Polynomials, but applying boundary conditions appropriate to the Schroedinger equation. (See the Miller article in this issue.) Thus, the Ramsauer experiments were the first to show the existence of diffraction and interference, albeit indirectly, even before Davisson and Germer

There followed a paper by **Michael Nauenberg, Department of Physics, University of California, Santa Cruz, Newton’s diffraction experiments.** He describes his paper here:

This year marks the tercentenary of the publication of Newton’s Opticks containing his celebrated theory and experiments on colors, which first appeared in the 1672 Philosophical Transaction of the Royal Society. It is still fairly unknown, however, that in this book Newton also reported several beautiful experiments on diffraction fringes obtained from various “slender” objects placed in a narrow beam of sunlight. In its preface Newton remarked that “the Subject of the Third Book [diffraction] I have also left imperfect, not having tried all the Experiments which I intended when I was about these Matters, nor repeated some of those which I did try, until I had satisfied my self about all their Circumstances. To communicate what I have tried, and leave the rest to others for farther Enquiry, is all my Design in publishing these Papers (1).

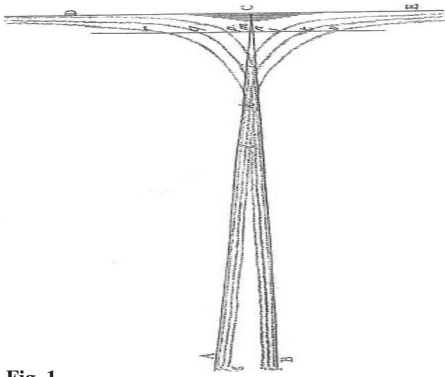


Fig. 1

Newton carried out a series of very careful measurements of the spacing of diffraction fringes as a function of the distance of the screen from the diffracting object. In his *Opticks*, he reported diffraction data from a strand of his hair, and from an ingenious slit with variable thickness made by the edges of two knives inclined relative to each other at a small angle (see Fig. 1). But these diffraction experiments posed insurmountable difficulties to his corpuscular theory of light. To explain the occurrence of color fringes in thin plates, which were originally described by Robert Hooke in his *Micrographia*, Newton assumed that light corpuscles traversing a medium, like air or glass, initiated oscillatory vibrations in this medium setting “fits of easy transmission and reflection” at the interface between two different media. But such a theory could not account for the diffraction fringes which are observed when light passes through a narrow slit or past a sharp edge.

I believe that it was this failure, rather than to avoid further disputes with Hooke, who died in 1703, that explains Newton’s long delay in publishing his book, which he had begun to write already in 1687, shortly after completing his *Principia*. Newton’s reservations about his attempts of a theory of diffraction are also revealed by the deletion of his name from the frontispiece of the first edition (1704) of the *Opticks* (2).

Recently I compared Newton’s experimental results on diffraction with the predictions of the Fresnel wave theory of light, and I found that his measurements were remarkable accurate (3) These experiments paved the way to Young’s correct explanation of the diffraction fringes as a wave interference phenomenon. Young aptly concluded that “the optical observations of Newton are yet unrivalled, and excepting some casual inaccuracies

they only rise in our estimation as we compare them with later attempts to improve on them”.

## REFERENCES

1. Isaac Newton, *Opticks* (Dover reprint 1979) p. cxxi
2. I. Bernard Cohen, *The case of the missing author: the title page of Newton’s Opticks 1704, with notes on the title page of Huygen’s Trait\’e de la Lumiere*, in “*Isaac Newton’s Natural Philosophy*”, edited by J.Z. Buchwald and I.B. Cohen (MIT Press 2001) pp. 15-45
3. Michael Nauenberg, *Comparison of Newton’s Diffraction Measurements with the theory of Fresnel*, in “*The Foundations of Newtonian Scholarship*”, edited by R.H. Dalitz and M. Nauenberg (World Scientific 2000) pp. 59-69

The next paper was by **Virginia Trimble, on Other Worlds**. Here, in her words, is a summary of the talk:

Some 2300 years ago, Epicurus taught that there are an infinite number of worlds like (and unlike) ours, and Aristotle taught that there is only one. Neither hypothesis can currently be falsified, though the past decade has seen remarkable success in the detection of planets orbiting other sun-like stars, one possible meaning of the phrase “other worlds.”

In fact the concept of *aperoi* cosmoi, multiplicity or plenitude of worlds, has had at least four separate meanings over the intervening centuries, each of which has a modern analogy. What Epicurus had in mind, and Aquinas later rejected for the Church, were completely separate (earth-centered) non-communicating universes. The 21st century analog is the multi-verses of self-reproducing inflationary cosmology.

Multiple worlds in temporal succession were suggested by Origen and, much later, Oresme. A cyclic universe (ruled out by general relativity if all the stuff around has non-negative energy density) is one modern version. The 3-d universes formed when higher-dimension branes collide and bounce off each other are also of this sort.

Third is the possibility that the moon, other planets, and even the sun might be inhabited. This dates largely from the post-telescopic era. Mars with the canals of Schiaparelli and Lowell and the moon with the forests sketched by Herschel belong to this tradition, as does the illustration of Cyrano de Bergerac (no, he wasn’t just a

character in someone else’s play) rising up to the moon at dawn in a very large dew-drop. The world he expected to find there was rather better than ours, and he was lucky to be living in a relatively permissive society, for the concept of better worlds, not just other worlds, appears to have been what got Giordano Bruno into trouble. The current version of other worlds within the solar system focussed on the possibility of liquid water on Mars in the past and under the dirty ice surfaces of large moons of Jupiter and Saturn.

Fourth and finally, one might think of other potentially detectable systems like ours, whether earth-centered (supporters including Bradwardine around 1330, Occam, who had a razor, and Buridan, who had an ass) or sun-centered, like Thomas Digges and Bruno had in mind.

This fourth idea leads directly, via a number of false alarms, to modern methods of detecting planets in orbit around other stars, of which there are at least two dozen, yielding so far more than 100 planets. All but a few of these have been found by a single method, period residuals in radial velocities of their host stars. Nearly all exoplanets so far are at least as massive as Saturn, orbit stars that are relatively rich in heavy elements, and have periods less than about a decade. The first and third are observational selection effect, and ways of overcoming these limits are on the horizon.

There were lots of pictures, and, in the post-talk discussion, our new fellow, Frieda Stahl suggested that the moon might be of greater importance to life on earth than the speaker had indicated, because of its role in stabilizing the terrestrial rotation axis. Just how important this is probably depends on how well you like unexpected major changes in your environment

The last paper was by **William Shields, of Virginia Tech, on Karl Popper’s Quantum Ghosts**. Shields submitted the following resume:

Karl Popper, though not trained as a physicist and embarrassed early in his career by a physics error pointed out by Einstein and Bohr, ultimately made substantial contributions to the interpretation of quantum mechanics. As was often the case, Popper initially formulated his position by criticizing the views of others\*in this case Niels Bohr and Werner Heisenberg. Underlying Popper’s criticism was his belief that, first, the “standard



interpretation” of quantum mechanics, sometimes called the Copenhagen interpretation, abandoned scientific realism and second, the assertion that quantum theory was “complete” (an assertion rejected by Einstein among others) amounted to an unfalsifiable claim. Popper insisted that the most basic predictions of quantum mechanics should continue to be tested, with an eye towards falsification rather than mere adding of decimal places to confirmatory experiments. His persistent attacks on the Copenhagen interpretation were aimed not at the uncertainty principle itself and the formalism from which it was derived, but at the acceptance by physicists of an unclear epistemology and ontology that left critical questions unanswered. Though Popper died in 1994, his influence in this field of physics has continued.

In early 2000, University of Maryland physicists Yanhua Shih and Yoon-Ho Kim reported the results of a “realization of Popper’s experiment.” Their experimental setup did not use Popper’s point particle source (such as a decay of positronium) it used entangled photons produced by a laser and refracted by lenses through slits. Their results, taken at face value, appeared to show a violation of the uncertainty principle. This would mean, from Popper’s point of view, that the Copenhagen interpretation is in error. But Shih and Kim argued that it is impermissible to apply the uncertainty relations to each of the entangled-state photons separately. These photons are, in their view, represented by a “nonfactorizable two-dimensional wave packet” such that “\*y\*py \*\* is not applicable to either photon 1 or photon 2 individually.” They concluded: “Our experimental demonstration of Popper’s thought experiment call (sic) our attention to the important message: the physics of an entangled two-particle system is inherently different from that of two individual particles.”

Shih and Kim’s papers (see below) has generated a flurry of responses, comments, criticisms, and suggestions for further work. A number of papers published since 1999 have explored the implications and practicality of “Popper’s Experiment,” and it is likely that more experiments will pursue the issue that virtually obsessed Popper: does human knowledge alone have physical effects?

Shih, Yanhua, Kim, Yoon-Ho, “Experimental Realization of Popper’s Experiment. Violation of the Uncertain-

ty Principle?” Fortschr. Phys. Vol. 48, 463-471 (2000); Shih, Yanhua, Kim, Yoon-Ho, “Quantum Entanglement: From Popper’s Eraser to Quantum Eraser,” Optics Communications Vol. 179, 357-369 (25 May 2000).

**Bonebrake Theological Seminary—Most Secret A-Bomb Project Site by Katherine and Elisabeth Sopka FO-CAS—Four Corners Analytic Sciences , see separate article.**

## **On Advising Congress and the President , John H. Gibbons**

**Annual American Physical Society Meeting Denver, Colorado May 3, 2004**  
**Abstract:**

*I devoted two decades trying to enable elected policymakers improved access to science and technology issues, and to bringing trained scientists and engineers into government. After two years of establishing and directing the Office of Energy Conservation (under President Nixon), 13 years as Director of the U.S. Congressional Office of Technology Assessment (OTA), and more than five years serving the President as Science and Technology Advisor, I can confirm Victor Hugo’s observation that “Science says the first word on everything and the last word on nothing.” There are strong similarities, but also major differences in the functions of advisor to the Congress vs. advisor to the President. These differences are discussed by examples; lessons learned will be drawn. One conclusion is that, given today’s S&T-laden governance issues, it is imperative to continue to try to bridge the communication “gap” between natural science and politics so aptly defined long ago by C.P. Snow. That gap shows up not only in the different “languages” used but also, for example, in different sensitivities to near-term vs. long-term issues.*

*I conclude that while great progress is being made despite serious setbacks, the potential contribution from S&T analysis/advice to all branches of government is much greater than currently exists. Our community can be more helpful by heeding lessons learned, participating in and reinforcing first-rate analyses, and countering the efforts of those who attempt to make political gains out of purposeful distortions of scientific consensus. Mark Twain once observed that “a lie can travel halfway around the world before truth can*

*put on its shoes.” In matters of S&T policy our community needs to learn how to put on our shoes more promptly...and keep them on!.*

After nearly two decades “playing hard” at the bench of experimental physics, I had the honor and (oft-times) pleasure of drifting into the twilight zone between government and the science, engineering, and technology communities. On many occasions over the past thirty-odd years of “science advising,” my wife has probed me about why it was that I left the relatively calm waters of research for such a turbulent second career.

The explanation is easy. Challenging and rewarding as research is, I felt a need to forge closer links between the perspectives and activities of scientists and those of politicians. It is not a new idea. Our earliest (U.S.) founders, especially Franklin, Jefferson, Hamilton, and Madison, recognized the essential value of knowledge in the new nation’s future and consequently the imperative for public and private interests to be joined in sustained support of scientific research as well as wise governance of technology.

That theme appears and reappears in our nation’s history, replete with spectacular successes in areas such as agriculture, biotechnology, communications, energy, health, transportation, environment, space, and fundamental sciences. But the explosive emergence of S&T since WWII in both the civil and military sectors soon made it clear that the cornucopia of S&T inescapably requires both support and societal governance. Virtually every powerful discovery presents opportunities both for good and ill. As Ralph Waldo Emerson once observed, “Nature never gives anything to anyone: everything is sold. It is only in the abstractions of ideas that choice comes without consequences.”

Despite the fact that the priorities and processes of governance involve S&T, those who seek leadership in politics seldom are technically literate. The two professions do not tend to attract the same types of personalities. Fortunately such socially concerned men as Einstein, Szilard, W. Golden, V. Bush, H. Brooks, J. Wiesner, G. Brown helped to establish the institutions and procedures of S&T governance and support we enjoy today.

I’m a relatively late-comer, but I also have had a full measure of experience

in S&T advising to both Congress and the White House. This short essay draws on the realities of those experiences and lessons learned along the way.

## S&T “Advice” to the Congress

In the face of mounting controversy about how to resolve issues such as the proposed civilian supersonic transport (SST), nuclear power plant siting, and oil tanker safety, and with the able assistance of the National Academy of Sciences, Congress established its Office of Technology Assessment (OTA) in the early 1970’s

OTA’s addressed Congressional committees’ concerns about how to treat oft-conflicting technical claims about technology. The challenge for OTA was to accurately, fairly, and authoritatively provide the Congress (and the public) with an accurate but understandable description of the chosen issue, explanation of the controversy or confusion surrounding it, and alternative ways to treat the public policy aspects of the issue.

The bottom line description of the job of science and technology advisor to Congress was to be aware and sensitive to the political process and to provide authoritative, timely and helpful advice but not to take sides beyond presenting findings. Thus the “advisor” best served his job not by advising in the traditional sense, but by presenting thoughtful, authoritative findings and options. Since OTA’s was a completely open process (except for classified work), an important aspect was its two-way accessibility to all comers. I see that function as highly responsive to James Madison’s admonition in a letter he wrote in 1822, “A popular government, without popular information, or the means of acquiring it, is but a prologue to a farce or tragedy; or, perhaps both. Knowledge will forever govern ignorance, and a people who mean to be their own governors must arm themselves with the power which knowledge gives.”

## Science

The work history of different science advisors is highly varied—by necessity—because the job must be defined by the President to meet his management style and priorities. In past times the science advisor’s relationship with the President (and White House staff) ranged from very personal (e.g., Wiesner-Kennedy) to almost non-existent (one advisor was relegated to the National Science Foundation). In my

case I had the great fortune of being fully utilized by both the President and the Vice President because of their mutual conviction of the central importance of science and technology in serving the overarching goals of economy, security, health, environment, and the advance of knowledge to provide for the future. Science and technology also were seen as key tools in deficit reduction (e.g., higher productivity in government operations through technology and better interagency links such as merger of civil-military weather satellites, space launch research, providing commercial access to geo-positioning satellites [GPS]), in international affairs (e.g., cooperation in disarmament, “big” science, health, space). Finally, the President charged me to forge more productive “partnerships” in the national interest between federal agencies and the private sector (e.g., the Partnership for a New Generation of Vehicles [PNGV]).

Along the way, as Science Advisor, I was deeply engaged in the resolution of issues such as cessation of underground nuclear weapons testing and the futures of the space station and the Super-conducting Super Collider (the latter two inherited from previous administrations). Also I was responsible for a myriad of other duties including the heading of national telecommunications in case of a declared national emergency; review and approval of the launch of the (plutonium isotope-powered) Cassini mission to Saturn; State functions such as bilateral international commissions on science and technology and various ceremonial events linking the President and Vice President to honor Nobel Laureates, Presidential Medals of Science and Technology, awards to science and math teachers, recognition of Astronauts, and others.

The job of Science and Technology Advisor to the President, while heavily dependent upon the priorities and personalities of the President and the Vice President, is inherently diffuse and diverse. S&T Advisers who hold high-level policy positions in the White House (for instance, Allan Bromley and I) have the opportunity and the authority to deal at the highest levels of governance. Regrettably our current President has down-graded the position, encumbering the abilities of Jack Marburger to contribute to policy-making, at the very time we need careful reasoning and thoughtful analyses as inputs to

decision-making.

## REPORT ON APS ACTIVITIES—THE WORLD YEAR OF PHYSICS

by Alan Chodos, Associate Executive Officer, APS

Readers of this Newsletter do not need to be reminded why 2005, as the centennial of Einstein’s “miraculous year”, is an appropriate time to celebrate the World Year of Physics. The World Year has been endorsed by the International Union of Pure and Applied Physics (IUPAP), by the United Nations Educational, Scientific and Cultural Organization (UNESCO), and by the General Assembly of the United Nations itself, thereby making it not only the World Year but also officially the International Year of Physics. A resolution declaring 2005 the Year of Physics has also passed the US House of Representatives, and a similar resolution is pending in the Senate.

In the US, the APS and its various units are spearheading WYP activities. The goal is to bring the importance and excitement of physics to the public. It is not generally known, but the World Year of Physics was inspired by the year of physics organized in Germany in 2000, which was stunningly successful: as one yardstick, enrollments of entering physics majors jumped about 25% in a single year, with more modest but steady increases in the years after that.

The central location for finding out about the WYP and for posting events in the US is the WYP web site, [www.physics2005.org](http://www.physics2005.org). The site is filled with comprehensive information and is continually being updated. Below I describe some of the projects and events that might be of particular interest to members of the FHP.

Together with the Topical Group on Gravitation and the Division of Astrophysics, the FHP is participating in a speakers’ program to provide good public speakers about Einstein and physics for the general public. Information on this activity is available at the WYP web site.

An event of likely interest to FHP members is the Einstein International Gala, which will take place in Washington on February 20, 2005 in conjunction with the AAAS annual meeting. Details are still being worked out, but the current concept is to have actors, in costume and in character, at the gala representing

notable 20th-century physicists. They would be sponsored by the embassies of the physicists' countries: Denmark for Bohr, Germany for Heisenberg, Italy for Fermi, etc. Einstein himself will also be there, and if anyone reading this wants to have Einstein at a WYP event, please contact me (chodos@aps.org) and I'll put you in touch with someone who modestly bills himself as the world's foremost Einstein impersonator.

The WYP also has the potential to give rise to a major scientific discovery, and any FHP member with a broadband internet connection can be part of the effort. As a direct result of the WYP, the Laser Interferometer Gravitational-

wave Observatory (LIGO) is collaborating with the APS on a distributed computing project, Einstein@home. This is similar to the well-known SETI@home, but instead of searching for extra-terrestrial intelligence, participants will besifting actual LIGO data in a search for gravitational waves. It is possible that Einstein@home will provide the first bona fide detection of these waves, which of course are a key prediction of Einstein's general relativity. The project will become operational in early 2005, but participants can sign up now at the WYP-web site, to ensure that they will be notified as soon as the Einstein@home screen-saver becomes available.

Physics departments and other institutions around the country are being urged to stage local WYP events. These will be the core of the WYP effort in the United States. Anyone who needs ideas and other assistance in organizing an event can get help at the WYP site; anyone who is already planning an event can enhance its visibility by registering it in our searchable data base.

FHP members, more than most others, are aware of the momentous significance of Einstein's achievements in 1905. We hope that you will join with us to help make 2005 another miraculous year.

## Notes, Reports and Announcements

### The Seven Pines Symposium— Report by Roger Stuewer

The Seven Pines Symposium is dedicated to bringing leading historians, philosophers, and physicists together for several days in a collaborative effort to probe and clarify significant foundational issues in physics, as they have arisen in the past and continue to challenge our understanding today.

The eighth annual Seven Pines Symposium was held from May 5-9, 2004, on the subject, "Quantum Mechanics, Quantum Information, and Quantum Computation." It was held in the Outing Lodge at Pine Point near Stillwater, Minnesota, a beautiful facility surrounded by spacious grounds with many trails for hiking and bird-watching. Its idyllic setting and superb cuisine make it an ideal location for small meetings. Its owner, Lee Gohlike, is the founder of the Seven Pines Symposium; he outlined its goals in his opening remarks.

Unlike the typical conference, the talks are limited to 30 minutes, twice as much time is devoted to discussions following the talks, and long midday breaks permit small groups to assemble at will. As preparation for the talks and discussions, the speakers prepare summarizing statements and background reading materials that are distributed in advance to all of the participants. Twenty-two prominent his-

torians, philosophers, and physicists were invited to participate in this year's symposium. Adrian Cho, writer for *Science* magazine, also attended.

Each day the speakers set the stage for the discussions by addressing major historical, philosophical, and physical issues pertaining to the subject of the symposium. Thus, the morning of Thursday, May 6, was devoted to the general topic of "The Copenhagen Spirit," with Michel Janssen (Minnesota) speaking on "Quantum Dialogues, 1925-1927" and Don Howard (Notre Dame) speaking on "Quantum Dialogues, 1955-1960." That afternoon the general topic was "Interpretations of Quantum Mechanics," with Geoffrey Hellman (Minnesota) and Jeffrey Bub (Maryland) speaking on "Major Interpretive Issues" and James B. Hartle (UC Santa Barbara) speaking on "Decoherent Histories." The morning of Friday, May 7, was devoted to the general topic of "Computability and Computational Complexity," with Itamar Pitowsky (Hebrew University) speaking on "Turing and Other Concepts of Computing" and Gregory J. Chaitin (IBM) speaking on "Computational Complexity Theory." That afternoon the general topic was "Quantum Information," with Charles H. Bennett (IBM) speaking on "Introduction to Quantum Information" and Christopher A. Fuchs (Bell Labs) speaking

on "Quantum Mechanics from Information Theory." The morning and afternoon of Saturday, May 8, was devoted to the general topic of "Quantum Communication and Computation," with Markus Aspelmeyer (Vienna) speaking on "Teleportation," John P. Preskill (Caltech) speaking on "Introduction to Quantum Information Science," William G. Unruh (British Columbia) speaking on "What is Quantum about Quantum Computing?" and Gerard J. Milburn (Queensland) speaking on "Realizability." Before dinner on Friday, May 7, Alan E. Shapiro (Minnesota) also spoke on "Newton Writes his *Opticks*: On the 300th Anniversary of its Publication." The closing discussion on Sunday morning, May 9, was chaired by Roger H. Stuewer (Minnesota).

Lee Gohlike, the founder of the Seven Pines Symposium, has had a lifelong interest in the history and philosophy of physics, which he has furthered through graduate studies at the Universities of Minnesota and Chicago. To plan the annual symposia, he established an advisory board consisting of Roger H. Stuewer (Minnesota), Chair, Jed Z. Buchwald (Caltech), John Earman (Pittsburgh), Geoffrey Hellman (Minnesota), Don Howard (Notre Dame), Alan E. Shapiro (Minnesota), and Robert M. Wald (Chicago). Also participating in the eighth annual Seven

Pines Symposium were Armond Duwell (Pittsburgh), Anthony J. Leggett (Illinois), Serge Rudaz (Minnesota), and Philip Stamp (British Columbia).

The ninth annual Seven Pines Symposium will be held from May 4-8, 2005, on the subject, "The Classical-Quantum Borderlands."

## History of Science Society

The History of Science Society will be holding its general meeting in Austin, Texas, joint with the Philosophy of Science Association, 18-21 November. A very large program is scheduled. Of particular interest to Forum readers are the following sessions:

*Rethinking National Security and American Physics 50 Years after the Oppenheimer Hearing* Schwartz, Mullet, Kaiser; Chair Nye

*Astronomy and Representation in the Nineteenth Century*: Henchman, Gossin, Canales; Commentator MacDuffie, Chair Henchman

*The Politics of Cosmology in Early Modern Europe*: Friesen, Miller, Jensen, Broecke, Commentator and Chair Johns

*Theory Confronts the World*: Eisenstaedt, Molvig, Silva, Perovic, Chair and Commentator TBA

*The German Physical Society and National Socialism*: Beyler, Hoffman, Eckert, Chair and Commentator, Walker

Details of the meeting, and of the Society, can be found at <http://hssonline.org>

**APS CONGRESSIONAL SCIENCE FELLOWSHIP:** The American Physical Society is currently accepting applications for the Congressional Science Fellowship Program. Fellows serve one year on the staff of a senator, representative, or congressional committee. They are afforded an opportunity to learn the legislative process and explore science policy issues from the lawmakers' perspective. In turn, Fellows have the opportunity to lend scientific and technical expertise to public policy issues.

Qualifications include a PhD or equivalent in physics or a closely related field, a strong interest in science and technology policy and, ideally, some experience in applying scientific knowledge toward the solution of societal problems. Fellows are required to be US citizens and members of the APS.

Term of appointment is one year, beginning in September of 2005 with partici-

pation in a two-week orientation sponsored by AAAS. Fellows have considerable choice in congressional assignments.

A stipend of \$50,000 is offered in addition to allowances for relocation, in-service travel, and health insurance premiums.

Application should consist of a letter of intent of approximately 2 pages, a list of key publications, a 2-page resume and three letters of reference. Please see the APS website [http://www.aps.org/public\\_affairs/fellow/index.cfm](http://www.aps.org/public_affairs/fellow/index.cfm) for detailed information on materials required for applying and other information on the program.

All applications must be postmarked by January 17, 2005 and should be sent to the following address:

APS Congressional Science  
Fellowship Program  
C/o Jackie Beamon-Kiene  
APS Executive Office  
One Physics Ellipse  
College Park, MD 20740-3843

**AIP STATE DEPARTMENT SCIENCE FELLOWSHIP** – This Fellowship represents an opportunity for scientists to make a unique contribution to U.S. foreign policy. At least one Fellow annually will be chosen to spend a year working in a bureau of the State Department, providing scientific and technical expertise to the Department while becoming directly involved in the foreign policy process. Fellows are required to be U.S. citizens and members of at least one of the 10 AIP Member Societies at the time of application.

Qualifications include a PhD in physics or closely related field or, in outstanding cases, equivalent research experience. Applicants should possess interest or experience in scientific or technical aspects of foreign policy. Applications should consist of a letter of intent, a two-page resume, and three letters of reference. Please visit <http://www.aip.org/gov/sdf.html> for more details. All application materials must be postmarked by November 1, 2004 and sent to: AIP State Department Science Fellowship, American Institute of Physics, Attn: Audrey Leath, One Physics Ellipse, College Park, MD 20740-3843.

**EDUCATION AND OUTREACH IN 2005**—Report by Virginia Trimble

Are you (a) reasonably good at speaking to and with students and (other) non-physicists and (b) interested in something that ties in with Einstein, 1905, or general relativity and gravitation? If so, then your help is needed.

FHP is collaborating with the Topical Group on Gravitation and General Relativity and the Division of Astrophysics to provide "World Year of Physics" speakers, especially for 4-year colleges, but also for community groups 2-year colleges, and so forth. An important goal is to encourage undergraduate science students to continue in science beyond the BS/BA degree. And, of course, we need from time to time to remind present and future voters and taxpayers what we are doing with their money and why.

There is already a web site where colleges, etc, interested in hosting a WYP speaker can go to make requests (a number of which have already come in). It is <http://www.phys.utb.ed/wypspeakers/REQUESTS/howto.html>

If you are willing to be a speaker in this program, please get in touch ([vtrimble@uci.edu](mailto:vtrimble@uci.edu)), providing your name, location, topic(s) you would talk about, and levels at which you would feel comfortable given talks, from K-12, through college and amateur astronomy groups, to "Princeton PhD's only").

**DIBNER INSTITUTE NAMES SENIOR FELLOWS, POSTDOCTORAL FELLOWS AND GRADUATE STUDENTS FELLOWS FOR 204-2005**

The Dibner Institute for the History of Science and Technology announced the appointments of the Dibner Institute Fellows for 2004-2005. The Institute will welcome eleven Senior Fellows, one Science Writer Fellow, two Senior Research Scholars, four Postdoctoral Fellows, five re-appointed Postdoctoral Fellows, and seven Graduate Student Fellows. Of particular interest to Forum readers among the senior Fellows are:

David Cahan, Professor of History at the University of Nebraska.

Olival Freire Jr, Professor, Universidade Federal de Bahia, Brazil, author of the book, *David Bohm e a Controversia dos Quanta*, 1999.

Giora Hon, University of Haifa, Israel, author of "Towards a Typology of Experimental Errors: An Epistemological View" (1989) and "Putting Error to (Historical) Work: Error as Tell-tale in the Studies of Kepler and Galileo" (Centaurus, 2003).

Cesare Maffioli, Ecole EuropTenne in Luxembourg, author of *Out of Galileo: The Science of Waters: 1628-1718* (Erasmus, 1994)

James Voelkel, author of *The Composition of Kepler's 'Astronomia Nova'* (Princeton, 2001) and *Johannes Kepler and the New Astronomy* (Oxford, 1999).

Among the postdoctoral Fellows are Peter Bokulich (Notre Dame) and David Pantalony (University of Toronto)

In addition several graduate student fellowships have been awarded

## WHO KNEW, I ?

**BONEBRAKE—Elisabeth Sopka**

*With the 60th anniversary now of the Manhattan Project and all its attendant publicity, one small, but crucial piece of this incredible effort remains largely undocumented. At the end of 1943, John Sopka, recent graduate in Physics from Harvard University, found himself on his way to Dayton, Ohio where he would serve as its first staff physicist. He is the source of much of this exposition.*

In June, 1943, Manhattan Project head, Gen. Leslie Groves, recruited one of the country's top commercial research chemists, Charles Allen Thomas, to serve as the lead scientist to coordinate all the chemical processing required for the plutonium bomb including the production of the Polonium-210 needed to supply the radiation for the bomb's initiator. Thomas was then Director of Monsanto Chemical Company's Central Research Laboratory based in Dayton, Ohio.



Bonebrake Seminary, Dayton Ohio

While all aspects of the Manhattan Project operated under extreme security, Thomas recognized that this work was particularly critical and chose to isolate it completely from all other parts of the Manhattan Project, siting it in Dayton. In September 1943, the Army Corps of Engineers leased from the city of Dayton an empty building, known as the Bonebrake Seminary, located at the edge of the downtown business district. The substantial, three-story building,

constructed of heavy brown stones in 1879 by the Church of the United Brethren, had been built originally as housing for seminarians attending the United Theological Seminary.

The interior of the building immediately underwent extensive renovation to accommodate administrative offices, various laboratories for chemistry, physics and electronics, a special Counting Room for measurements of radioactivity, machine shop and glassblowing facilities. Much attention was paid to the interior design to maintain security and to control contamination. Outside the building, the only change was to surround the property with a nine-foot cyclone fence, placing a small guardpost at the front entrance gate. Otherwise, no external evidence belied the building's change in status to a top-secret military research facility.

To staff the facility, Thomas initially drew largely from Monsanto, appointing Dr. James Lum as Laboratory Director in July, 1943. Dr. W. Conrad Fernelius was recruited from Purdue in August to serve as Chief Scientist. He rapidly assembled a team of chemists including R. W. Moshier, Carl Rollinson, Norman Coulter, Fred Leitz, Henry Kuivalla, John Schulte, R. A. Staniforth, E. M. Larsen and Louis Marchi among others.

The research at Bonebrake was essentially radiochemistry, a field in its infancy; it quickly became clear that significant support was needed in the areas of physics and electronics. Through the fall, physicist Dr. Donald Woernley was on loan from Monsanto until John Sopka arrived at the end of December, 1943, from Princeton University where he had been teaching mathematics.

The specific objective at Bonebrake was to develop a suitable process to extract and purify Polonium-210 needed as the emitter for the bomb's triggering mechanism. Although discovered more than 35 years earlier by Marie and Pierre Curie, prior to 1944, Polonium had never existed in sufficient quantity or purity to have its essential chemical and physical properties defined. Much early research at Bonebrake focused on extracting Polonium from lead residues, but it was soon determined that neutron-bombarded bismuth metal would be a more satisfactory source. It was arranged to have the Clinton Reactors at Oak Ridge bombard 50 lb Bismuth ingots

on a regular schedule and to have these delivered to Dayton.

The physicists at Bonebrake had two main areas of work: first, to provide the means to measure the amount and purity of Polonium produced by the chemists at each step in their extraction processes; second, to detect and measure radioactive contamination on both personnel and equipment.  $\alpha$  and  $\gamma$  radiation were measured using regular glass Geiger tubes with digital counters and from these measurements the amount of Polonium present in the samples was calculated. Direct measurement of the  $\alpha$  radiation intensity was desired because it was the crux of the bomb initiator, but, because a radiation cannot penetrate glass, standard Geiger tube technology could not be employed. So, almost immediately after arriving at Bonebrake, Sopka traveled to the University of Chicago's Metallurgical Laboratory to learn state of the art radiation measurement. He returned with two instruments called monitors. These ionization chambers, capable of measuring a radiation, needed adaptation to accommodate 1) the wide range of radiation levels presented by the various forms of samples, and 2) the differing physical characteristics of these.

The first test samples of Polonium were shipped to Los Alamos on March 15, 1944, less than six months after the start of the project. These early samples provided sufficient clear evidence of the suitable potency of Polonium, enabling scientists there to abandon work on the original gun-type plutonium weapon and to re-focus their efforts on developing the so-called 'Gadget' implosion device.

Throughout the Bonebrake Project, everything was conducted under utmost secrecy. Information was available to individuals within the project strictly on a 'need to know' basis. Those recruited to work on the project joined it without knowing anything about the purpose of the project. During their work, they only knew that bismuth ingots arrived from 'Site X' and purified Polonium was delivered to 'Site Y'. The first explicit reference to 'atomic bomb' and 'Trinity test' was made at Bonebrake on V-J Day, August 15, 1945. From the moment they arrived at Bonebrake, all employees were ordered to discuss their work with no one, including close family members. When they departed the project, as John Sopka did at the end

of August 1945, they were explicitly told 'Don't say anything, ever!' John Sopka first spoke of his experiences at Bonebrake Seminary in 2003 in preparation of the contributed paper for the April meeting described in this paper.

### **WHO KNEW, II?**

#### **Lord Rayleigh and the Air Force Research Laboratory at Hanscom AFB. Report by Thomas M. Miller, Research Physicist, Hanscom Air Force Base**

When I found that my branch of the Air Force Research Laboratory library had the notebooks and papers of one of the greatest of the 19th century scientists, Lord Rayleigh (John William Strutt, 1842-1919) (JWS), as well as those of his son, the 4th Baron Rayleigh (Robert John Strutt, 1875-1947) (RJS), I assumed that at some point we had had a head librarian who loved old books so much that he couldn't resist buying some now and then. This impression was reinforced by seeing many old journals on the shelves such as Phil. Trans. Roy. Soc. from 1665, and old oriental journals, some of which were purchased by the occupation forces in Japan. The idea isn't farfetched: Ed Murad, who has been at this laboratory for 38 years, said that "the good library years have been those when the library was run by people who loved books."

But, as it turns out, there was a legitimate research purpose behind the purchase, in 1962, of the Rayleigh materials. Physicists at what was then called the Air Force Cambridge Research Laboratory (AFCRL) had used airglow measurements to track the effect of solar activity on the upper atmosphere since 1950, but had little information prior to that year. They came across published data by RJS, with indications that he had made almost daily airglow measurements from about 1920 until his death in 1947, a period which would cover two 11-year sunspot cycles. After some effort, they found that the modern Strutt family had little interest in science, and had placed the scientific notebooks, manuscripts and papers in the hands of a London bookseller. The AFCRL librarians, Ole Groos and John Armstrong (both of whom died this summer) had enough control over discretionary spending to purchase the materials, which turned out to be a great treasure consisting of 12 notebooks by JWS, 22 by RJS, and 1 by Eleanor Mildred Sidgwick, among other

papers. And, yes, the AFCRL researchers were able to extract useful data on early sky brightness, which they published. The library also purchased the collected works of Sir George Stokes, which Stokes had presented to JWS, and which contains marginal notes by JWS. Mrs. Sidgwick was a sister-in-law of JWS, and a sister of Arthur Balfour, who became Prime Minister of Britain.

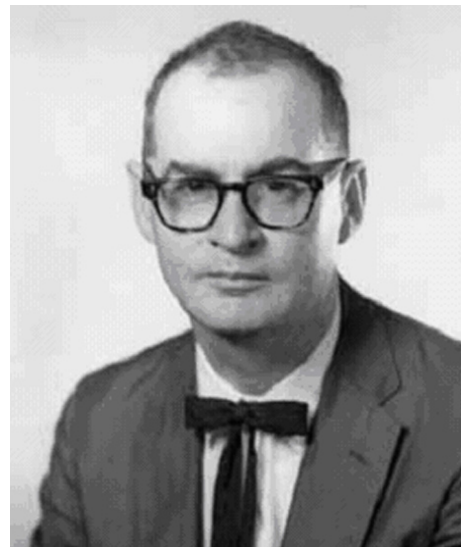
The Rayleigh materials became a second career for the AFCRL Chief Scientist, John N. Howard, a founding editor of the journal *Applied Optics*. He cataloged the notebooks and papers and had microfilm copies of all of the materials made for deposition at Imperial College and at the Niels Bohr Library of the AIP. He also edited a 3792-page Dover edition (1964) of Rayleigh's papers and added valuable notes and photographs. JWS's "Scientific Papers" is unique in that 5 of the original 6 Cambridge volumes (1899-1920) were printed while JWS was living, giving him the opportunity to correct errors in the papers and add notes. RJS completed the task for the 6th volume. A historian would thus be advised to read both the original papers and the Dover versions. [Dover might be wise to reissue the 1964 edition: an Internet search reveals only copies selling for many hundreds of dollars, and a single set of the original volumes selling for \$1150.] Howard also organized a section of *Applied Optics* (Vol. 3, issue 10, 1964) which contains several articles by Howard and others and RJS's sons Charles R. Strutt and Guy R. Strutt on the lives and science of WJS, RJS, and Mrs. E. M. Sidgwick. Howard reports that he gave many lectures on the Rayleigh papers in those years, and continues to receive one or two requests per year for information.

The earliest notebook in JWS's hand is titled "J. W. Strutt, Trinity College 1862" and contains 80 pages of notes from classes and texts. The 2nd and 3rd notebooks include notes on Stokes's lectures. The 8th notebook covers his discovery and isolation of argon in 1894, with William Ramsay, which earned him a Nobel Prize in physics, and Ramsay a Nobel Prize in chemistry, in 1904. The notebooks range in length from 50 to 326 pages. The final experimental note, on gratings, is dated 6 March 1919. The 12th notebook lists JWS's published papers and who requested copies of the papers over the years.

The notebooks in RJS's hand are more carefully written and indexed. The first starts in 1916 with work on gas phenomena. Others detail work on electric discharges and afterglows, optics, aurora, airglow, and spectra of the sky. The final notebook goes through October of 1944, ending with afterglow studies. These notebooks average about 150 pages each. Mrs. Sidgwick's notebook begins, "Cavendish Laboratory, April 1880". It records experimental observations on cirrus clouds, capillarity, viscosity, and soap bubbles, and contains notations by JWS.

One final note: there was no first Baron Rayleigh. George IV was to confer this honor on Joseph Holden Strutt, a Member of Parliament. Strutt did not wish to give up his seat in Commons, and had the honor transferred to his wife, who became Baroness Rayleigh. The current Baron Rayleigh, the 6th, is John Gerald Strutt (1960-).

Thanks are due Ed Murad, John Howard, and current AFRL librarians at Hanscom AFB, John Griffin and Margaret Wawrow, for information used in preparing this note.



**John Howard**

#### **Eri Yagi, Professor Emeritus of Toyo University, Tokyo. Director of Eri Yagi Institute for History of Science Kawagoe, Japan.**

In recognition of Professor Yagi's retirement from Toyo University the Editor asked her to prepare a brief summary of her career in the history of thermodynamics, and in particular of the work of Clausius.

Born in Tokyo, Eri Yagi received her undergraduate education in physics at

Ochanimizu Women's University, Tokyo. After studying under the late Professor Derek Price at the Department of History of Science and Medicine, Yale Graduate School (1960-63) during three years of leave of absence from the Department of Physics, the Graduate School, the University of Tokyo, Yagi received a Ph.D. in physics from the University in 1965. Her thesis was on several topics related to the history of physics in Japan, which developed a statistical approach to Japanese science, and considered the internal history of Nagaoka's atomic model and spectroscopy.

Yagi with two coworkers published in 1993, a catalogue to the Archives of Toshiko Yuasa, Ochanimizu Women's University, the first Japanese women physicist (1909-80).

For these twenty years, Yagi has been studying R. Clausius and his concept of entropy. Most of her papers on R. Clausius are compiled as a book; A Historical

Approach to Entropy, Collected Papers of Eri Yagi and her Coworkers, at the Occasion of Her Retirement, 2002, International Publishing Institute, Tokyo, Japan.

Firstly, Yagi started to work with Clausius's text analysis with the help of his Manuscripts, which were available at the Archives in the Library, Deutsches Museum, Munich. Through the text analysis, Yagi found Clausius was strongly influenced by J. Fourier's mathematical method in the analytical theory of heat (1822). Here Fourier was succeeded in obtaining only the second order differential with no first order within the volume element ( $dx dy dz$ ) by taking the difference between two flows (in and out) along x-axis. Clausius applied Fourier's method to various cases of physical phenomena, namely stationary flows with only gradual linear changes as light (1849), heat (1850) and electricity (1852).

In addition to the above traditional text analysis, Yagi and her coworkers have been exploring several useful methods

to study Clausius's mechanical theory of heat. They are the method of mathematical equation analysis, that of experimental table analysis, and that of technical term analysis. For that of mathematical equation analysis, Yagi and her coworkers collected about 500 equations as their own database from Clausius's 16 papers (1850-65) on the mechanical theory of heat which includes such three fields as thermodynamics, gas theory, and the theory of electricity. Through the use of the above database, the following important fact was realized that the first and second laws of thermodynamics are handled by Clausius as a related set of analytical equations. The database is published as a supplement with the above book; A Supplement of the collected Papers of Eri Yagi and her Coworkers, a Database from R. Clausius's *Abhandlungen I-XVI*, 2002. Eri Yagi Institute of History of Science, Rm 404 Honkawagoe 2nd LM, 30-4, Renjaku-cho. Kawagoe, Saitama, 350-0066, Japan. (written July 22, 2004)

## Book Reviews

**Elga Wasserman. *The Door in the Dream: Conversations with Eminent Women in Science.*** Joseph Henry Press (Washington DC) 2000. ISBN 0-309-06568-2. 253 + xiv pages. B&W photos. Preface by Rita Colwell

*Reviewed by Virginia Trimble*

Some of your friends are among the heroines of this volume: Esther Conwell, the late Gertrude Scharff Goldhaber, our own past president Myriam Sarachik, Vera Rubin. The population pool contained the 86 women elected to the National Academy of Sciences before 1 July 1996 and still living at that time. About 10 have since died. A subset of 26 (with birth years spread from before 1900 to after 1950) are the subjects of 2-5 pages mini-biographies, some entirely in the words of the author, others with extended quotes from the subjects, who were interviewed on paper or by telephone, primarily in 1995. Every one of the stories has something to inform or inspire the reader. But I started on the wrong page (219-220), where I found the following, and really never recovered: "Because most

institutions have been reluctant to address the issues brought about by changing lifestyles among their employees, women scientists must either juggle roles as scientists, wives, and mothers without help from the institutions in which they work or forgo having children. No male scientist has to confront such a Hobson's choice." Immediately I was transported in memory back to a summer day in Aspen, Colorado, where the conference program required (perhaps it still does) participants to check into their accommodations and to being attending sessions on Monday morning. I stood next to a colleague, who was juggling a small bag of groceries, a door key, a notebook, and the hand of a child, who said "You know, this schedule just isn't designed for single parents." He was (and I wasn't), and you can surely think of examples among your colleagues of men who have had to tackle equally difficult choices between careers and families. Nothing is said about issues facing same-sex couples. Perhaps there are none among the academicians, but I, and surely you, know a good many among productive scientists

who are not (yet) NAS members. On the plus side are some interesting speculations on why, with both the biological and the physical sciences starting from roughly 0% women 75 years ago, the former has changed so much more rapidly than the latter. On the minus side, I wish the author had been more generous in providing the birth names of her biographies and had somewhere explained the meaning of the subtitle. It must be a quotation, but not one that rates a listing in Bartlett's, which has only Jung explaining that a dream is a door.

**Robert Zimmerman. *Leaving Earth-space stations, rival superpowers, and the quest for interplanetary travel.*** Publisher: Joseph Henry Press, Washington, D.C. 2003

*Reviewed by Robert K. Soberman*

Space and history buffs alike will enjoy reading this detailed description of mankind's space travel beginnings from the dreams of science fiction authors like Jules Verne and Willy Ley, through the launch of Sputnik in 1957 to December 2002 when the book was completed. Let not the his-

tory lesson deter you as the book, though replete with references and the results of first hand interviews, contains excitement, poignancy and edge of chair suspense.

For American space professionals and enthusiasts alike the book offers an “in depth” look at the formidable Russian space effort traditionally slighted or totally ignored in the western press. The exploits of cosmonauts, famous in the former Soviet Union (FSU) and later Russia, are described. Their backgrounds, training and in cases where important, their families and personal lives are detailed. After Sputnik and the first animals and humans to orbit the Earth, the press devoted most stories to the American winning of the Moon race. Little noted was the Russian capture of all records for human and equipment endurance in space. Zimmerman points out that while the American manned program lost its direction after the lunar landings, the Russian program remained focused upon manned missions to Mars and beyond, despite technical failures, political upheavals and virtual bankruptcy.

Zimmerman contrasts the secrecy that pervaded and hampered the FSU space program with the publicity given the American effort. However, he neglects or is unfamiliar with, the head start the Soviets gained from their approach to the intercontinental ballistic missile (ICBM) problem that faced the two post World War II (WWII) superpowers. To transport a nuclear bomb one quarter of the way around the globe, Americans worked to make the bomb as small and light as possible. The Soviets, on the other hand, designed their rockets to carry the comparatively large and massive early bombs. Their superior launch capabilities became evident about 1960. After Sputnik, Prof. Fred Whipple of the Harvard-Smithsonian Astrophysical Observatory organized Operation Spacewatch where volunteers visually tracked artificial satellites. Members reported that they had observed a piece of a re-entering satellite that imbedded itself in a Midwestern crosswalk. The alleged satellite fragment was brought to Cambridge, Massachusetts for examination. As then Chief of the U.S. Air Force Meteor Physics Branch, I was present. Faced with this semispherical iron slug about six inches in diameter, knowing the lightweight fragile aluminum American satellite

structures, all but the Spacewatch volunteers were convinced we were looking at an iron meteorite. It was not until it was cut open to reveal an imbedded metric screw that its manufactured origins were given credence. Later, in a meeting with one of my FSU counterparts in Moscow, I was shown some experimental apparatus being flown on Soviet satellites to measure micrometeorites. Apparently, little if any effort was devoted to making the equipment smaller and/or lighter.

Countering, to some degree, the early Soviet superior launch capabilities was the participation of Wernher von Braun and his German colleagues in the United States space program. When U.S. troops first reached the Nazi V2 rocket base at Peenemünde, General Electric engineers, under government contract, brought whatever equipment and personnel they found to the United States. This formed the basis for the U.S. Army’s missile center in Huntsville, Alabama. During the mid 1950’s the U.S. Air Force was given sole responsibility for ICBM development. Numerous highly regarded scientists blocked any Air Force investigation into ablation as a means of surviving atmospheric re-entry. Only when von Braun’s group demonstrated successful intermediate range ballistic missile (IRBM) re-entry with a wood coated nose cone did the Air Force begin ablation research. Later, after von Braun’s group became the foundation for a NASA center at Huntsville, they designed and built the Saturn V launch vehicle for the Moon mission. This was the first U.S. rocket to exceed Soviet launch capabilities.

A few of the practical jokes and antics the astronauts/cosmonauts played upon one another and on ground controllers are described. It helps to highlight the very human nature of these explorers.

Successes and failures are elucidated. The book keeps the reader in suspense as oft-innovative spur of the moment repairs save lives from imminent space disasters. While the jury-rigged umbrella that saved Skylab is familiar to most western space enthusiasts, equally or more dangerous failures aboard Soviet/Russian spacecraft such as fires and collisions were deliberately kept from the public lest they jeopardize future funding.

As the political and financial environments were/are critical to the space program, the author provides those backgrounds for the reader. He describes the

mood of cosmonauts aboard the Mir Space Station while the Soviet Union collapsed below them and Boris Yeltsin formed the Russian Federation that took over the program. While space was always political, we read here how President Clinton used it as a conduit to provide cash to the near bankrupt Russian government to prevent their return to Communism.

The book concludes on a somber note. The Russian and U.S. space programs have passed each other traveling on opposing paths. While the Russians have become freer and continue to follow paths to economic independence, NASA has become a bureaucracy of the type the former FSU would have envied. It is largely populated by “apparatchiks” whose primary concern is enlarging their fiefdoms. Where the cosmonauts have been given greater freedom to improvise and perform independent research, astronauts have been placed under ever more rigid ground control. This is counter to what would be required of interplanetary voyagers. Incidentally Zimmerman exaggerates the time delay for one way Mars mission communication at 20 minutes, which is the maximum when Earth and Mars are in superior conjunction (furthest in their orbits from one another, on opposite sides of the Sun). However, even half that could easily prove catastrophic if emergency directions must be received from mission control on Earth.

**Brian Austin Schonland: *Scientist and Soldier Institute of Physics Publishing, Bristol and Philadelphia***

*Reviewed by Richard Collins, Emeritus Professor of Physics, The University of Sydney*

This is a remarkable book about a remarkable man. The book is simultaneously a thoroughly researched and referenced academic history, and a most readable account, of the life of a person once wdescribed as “South Africa’s scientist of the (20th) century.” As I read through it, I found myself becoming progressively more surprised, and perhaps even a little embarrassed, that I had never heard of its subject before. As noted by the author in the preface, however, the name of Schonland is not widely known, even in his home country.

Basil Schonland was born in 1896 into an academic South African family, and demonstrated outstanding scientific



abilities at an early age. After the completion of his first degree at Rhodes University College, he went to the Cavendish Laboratory at Cambridge to undertake a Ph.D. under Rutherford. These studies were interrupted for a time when he served in the First World War. Upon completion of this degree, he returned to South Africa and took up a post at the University of Cape Town. Realizing that his isolation would make it impossible to continue effective research in nuclear physics, he commenced work on understanding the physical processes that occur in lightning – something in plentiful supply in South Africa – and developed an international reputation in this field. In 1936 he was appointed to the Carnegie-Price Chair of Geophysics, and Director of the Bernard Price Institute for Geophysical Research, at the University of Witwatersrand. In 1938, he was elected a Fellow of the Royal Society for his work on lightning. Early in the Second World War, he undertook pioneering research on radar in South Africa and led the group responsible for development of the first working radar systems in that country. He again went to England during this war, and utilized his outstanding scientific, managerial and organizational skills in support of Britain's war effort, including a period as scientific adviser to Montgomery. After the end of the war, he returned to South Africa to set up and lead that country's Council for Scientific and Industrial Research, while also continuing part time with his work at the University of Witwatersrand. A decade or so later, he relocated again to England and shortly afterwards succeeded Sir John Cockcroft as Director of Harwell, in which capacity he served until his retirement.

If this book simply chronicled Schonfeld's achievements during his life, it would be a most worthwhile addition to the history of science, particularly in an area that has been somewhat neglected in the past. The author does much more than this, however. Through the existence of extensive personal records, including Schonfeld's own diaries and letters written by him, and aided by many face-to-face interviews with Schonfeld's contemporaries, the reader is given revealing insights into the personal attributes of the person. They show a modest, even shy man who, unlike many of his contemporaries and despite his quite extraordinary achievements, appears

to have no ego or pretensions to self-importance. At the same time we find him driven to make advances in fundamental science, and to do useful things for his home and adopted countries. He was a man who was much loved, and who inspired others.

A carefully researched history such as this is illuminating for the picture that it paints of the views of senior scientists of the day. Like his colleagues, Schonfeld clearly saw the pursuit of new knowledge through basic, fundamental, "pure" research as a higher calling – something superior, and to be better regarded, than mere development, or mission-oriented science, although much of his work was in the latter categories. In this regard, his views mirror those of Cockcroft, in whose shadow he moved through much of his life. He appears to have been subjected to considerable pressure during his term as Director of Harwell to manage the organization in more directed ways than when it was under Cockcroft. In a very real sense, Schonfeld seems to have suffered somewhat from the legacy of his predecessor's hands-off management style – Cockcroft seems to have believed that Harwell should operate in much the same way as a university research department. It is intriguing how, when Schonfeld assumes this responsibility, the story shifts from his own achievements to the activities of his organisation. His life seems to be consumed with the crises, both scientific and political, that inevitably occur in the operation of such an organisation. One senses that he did not enjoy his time in this position as much as when he had lesser responsibilities.

One of the great values of a book such as this is its completeness. We are given highly detailed insights into the science that Schonfeld did, to the way that he thought, and to the nature of his relations with his masters, peers, subordinates, and with his family. The author is to be commended for the way that he has so thoroughly researched and drawn from the extensive published and personal records, and from the material gathered during the interviews that he carried out. The detail is such that the reader is at times left with the impression that the author could not bear to leave anything out, and that the book might have benefited from a slightly heavier hand by the publisher. This is a minor criticism, however, and the occasionally tedious detail

is a small price to pay for the remarkable insights that we are given into the life and person of a very significant and influential scientist who, until now, had been nearly forgotten. This is an important book, and a good read.

**Charlotte Froese Fischer: *Douglas Rayner Hartree, His Life in Science and Computing***

*Reviewed by Walter R. Johnson, Professor of Physics Notre Dame University*

Charlotte Froese Fischer, Hartree's final doctoral student and the one that followed most closely in his footsteps, is author of this interesting and informative biography written from a physicists' perspective, complete with a family tree, photographs, letter excerpts, testimonials from students and associates, tables of angular couplings, and mathematical formulas. She not only describes Hartree's contributions to physics, but also discusses his interactions with other luminaries of early twentieth-century physics: Bohr, Rutherford, Dirac, Eherenfest and Einstein, to mention a few.

This biography covers Hartree's family heritage, early education, World War I work on ballistics, early research at Cambridge, doctoral research on atomic physics, development of self-consistent field theory, research on radio waves,

Manchester years, differential analyzer, control theory, service during World War II, Cambridge years and the dawn of the computer age.

Douglas Rayner Hartree was the oldest of the three sons of Eva Rayner, Mayor of Cambridge and president of the National Council of Women, and William Hartree who taught engineering at Cambridge University. Hartree's two younger brothers died before reaching adulthood. He became interested in mathematics at the Bedales school in Petersfield. (The Bedales school website mentions Sarah Armstrong Jones, Minnie Driver and Daniel Day-Lewis as illustrious alumni but, alas, fails to mention Hartree.) In 1915, Hartree entered St. John's College Cambridge. His education was interrupted by World War I during which time he worked with the Ministry of Munitions on ballistics and anti-aircraft gunnery. He returned to Cambridge after the war and graduated in 1921. In 1923, Hartree married Elaine Charlton; they had three children. Hartree completed his doctorate (atomic structure calculations based on Bohr's theory of the atom) in

1926, just at the time that principles of quantum mechanics were being developed by Schroedinger and Heisenberg.

After his doctorate, Hartree turned to wave mechanics and applied the expertise in numerical methods that he gained during the war to the calculation of atomic self-consistent fields and wave functions. In 1928, he published four seminal papers on the self-consistent field approach to atomic structure. Hartree was elected Fellow of St. John's College 1924-1927 and Fellow of Christ's College 1928-1929.

In 1929, Hartree was appointed Professor of Applied Mathematics at Manchester. He held that position until 1937 when he moved to the Chair of Theoretical Physics. In 1932, he was elected Fellow of the Royal Society. Hartree visited Vannevar Bush at MIT twice in 1932-1933 to learn about the differential analyzer. After his return to Manchester, he built a simple differential analyzer from Meccano toy parts. He later supervised construction of a more sophisticated (8 integrator) differential analyzer. In 1935, Douglas was joined in his calculations of atomic self-consistent fields by his father, William, who took responsibility for much of the numerical work.

In 1946, after working with the Ministry of Supply during World War II, Douglas Hartree was appointed Professor of Mathematical Physics at Cambridge, a position he held until his death in 1958. He was offered the Cambridge position while he was in the USA at the invitation of the US War Department advising on scientific applications of the ENIAC, the first general-purpose digital computer which was set up and operating at the University of Pennsylvania.

In addition to his work on atomic self-consistent fields, we learn that Hartree made significant advances in studies of reflection of radio waves from the ionosphere, control theory, stability conditions for the magnetron oscillator, and hydrodynamics of laminar boundary layers. He was author of six books and more than 100 journal articles on mathematical physics. Two of his books: *Calculation of Atomic Structures* (1957) and *Numerical Analysis* (1958) are considered by many to be classics of mathematical physics. Aside from physics and numerical analysis, Hartree played the piano and conducted an amateur orchestra.

He also maintained a lifelong interest in trains.

Again, this is a delightful and informative biography written by an expert on atomic structure theory, illuminating the life of a major figure in physics during the first half of the twentieth century.

**Owen Gingerich: *The Book Nobody Read, Chasing the Revolutions of Nicolaus Copernicus Walker & Company New York, N.Y. 10011, 2004***

*Reviewed by: Sidney Borowitz and Benjamin Bederson, New York University*

The author, Professor Owen Gingerich, is a Professor of Astronomy and the History of Science at Harvard University as well as an Astronomer Emeritus at the Smithsonian Astronomical Observatory. The book, one might think, should appeal mostly to bibliophiles, especially those interested in astronomy books published in the Sixteenth and Seventeenth centuries. However, despite the supposed narrowness of the subject matter of the book, it is so beautifully written and has sufficient gossip about the community of ancient astronomers as to be interesting even if one does not know whom he is gossiping about. Parenthetically, there is a modern mystery about a theft that author managed to solve and the author's role in bringing the culprit to justice.

In 1970, during a sabbatical leave he was spending in England, Gingerich was dining in York with an old friend and fellow astronomer from Poland, Jerry Ravetz. Copernicus had been born in 1473 and they were discussing the coming celebration of his Quinquecentennial since they were both on the planning committee for this event. Their conversation led them to discuss Copernicus' magnum opus *De revolutionibus* (the full title, translated, is *On the Revolutions of the Heavenly Spheres*), the 400 page book in which he hypothesized that the Sun stands still and the Earth and its planets revolve around it. In the course of the conversation Gingerich asked whether Ravetz thought anybody really had really read the book. The question arose because Arthur Koestler had asked the same question in his book, *"The Sleep Walkers"*. The details of the subsequent discussion are not important but consequences are.

Shortly after that evening Gingerich found himself in Scotland at the Royal Observatory in Edinburgh, examin-

ing a copy of *De revolutionibus*. This copy was richly annotated by a knowledgeable reader, who was later identified to be Erasmus Reinhold, a prominent sixteenth century astronomer. Gingerich became interested in the comments others might have made subsequent to its original publication, which could provide important insight into the thinking of contemporary astronomers concerning the impact and consequences of Copernicus' masterwork. With the conversation with Ravetz still fresh in his mind he decided to undertake a search for as many volumes of the Copernicus book he could find. About 1,000 first editions of the book had been printed in 1543, and about six hundred second edition in 1566.

His decision surprisingly led him ultimately to visit thirty-three countries and twenty states of the United States plus the District of Columbia. He managed to examine at least 600 copies of first and second editions of *"De revolutionibus"* photographing the comments he found in a great many of them, frequently made by distinguished astronomers. He measured the copies' dimensions and noted any unusual tears, omissions and other identifying marks. By these means he was able to identify sources and previous owners. With the help of Charles Eames, of furniture fame, he obtained photographs of Copernicus and his many distinguished contemporaries that he was able to find in museums and universities he was visiting. The result was a publication, *"An Annotated Census of Copernicus' De revolutionibus (Nuremberg, 1543 and Basel 1566)*. Nuremberg and Basel were the cities where the first and second editions respectively were published. The present volume is, basically, a personal story describing how that census was obtained. And, not incidentally, he uses this recounting to offer the reader a generous supply of his own knowledge and wisdom, as well as some admittedly controversial opinions, of the entire history of early astronomy. All the principal actors, from Brahe and Kepler on down appear, mainly through their own annotated copies of Copernicus. We are given the privilege of meandering through this marvelous period of scientific history with the skilled help of one of its most knowledgeable guides.

And, as documented by the many annotated copies that he personally ob-

served, both in the original and in copies, contrary to Koestler's statement, *De revolutionibus* seems to have been a sixteenth century best seller, widely read.

The Catholic Church's position about Copernicus' heliocentric assertion is presumably well known. But its position that heliocentrism is a hypothetical scheme useful for mathematicians but is not physical reality and is accordingly not to be condemned outright, is not so widely understood. (Does this resonate with Creationists' position on evolution?) Any hint that this was a real effect was to be met with censorship or worse. In the book we learn that the great astrophysicist Johannes Kepler wrote in of his notes that Copernicus thought that his theory was physical reality. This comment caused a great furor in the Church and among the astronomers of that era.

Good copies of *De revolutionibus* sell nowadays for hundreds of thousands of dollars at auctions. It is a great temptation for thieves to attempt to steal these valuable volumes. Gingerich's census was a valuable adjunct in establishing that such a theft has taken place. However, the value of the present book relates not so much to its documentation of inventory as to its insights into the impact that Copernicus had on the subsequent evolution of scientific thought leading, ultimately, to the final, correct, understanding of the basic workings of the Solar System by Galileo.

**David Lindley: *Degrees Kelvin, A tale of genius, invention, and tragedy*, Joseph Henry Press, Washington DC 2004**

*Reviewed by Benjamin Bederson*

David Lindley is the author of several well-regarded books, including *The End of Physics* (a fine book, although I didn't care much for the title), and a biography of Ludwig Boltzmann. Now Lindley has taken on the Nineteenth Century celebrity physicist, William Thomson, Lord Kelvin. It is a book of considerable charm, while also presenting a very well-rounded portrait of a most Victorian, talented, complex individual of mixed achievement. Lindley is by no means effusive over Lord Kelvin's accomplishments, and in fact he is somewhat lukewarm, finally, in his summary of Kelvin's scientific contributions.

Kelvin came from an academic background (his father was a professor of mathematics at Glasgow), and as is so often the case with later to become famous

physicists he showed early precociousness in mathematics. In his early years his "natural philosophy", i.e., physics, interests ranged widely across the then most challenging topics, especially in heat and thermodynamics and electricity. He early on acquired a mathematical style, based primarily on elegant French mathematical methods, most notably that of Fourier. However he became truly famous through his practical accomplishments. Which ancient reader of this Newsletter does not remember the mirror galvanometer, the instrument of choice for almost a century for measuring tiny currents? Most impressive was his leadership role in establishing measurement standards—temperature, of course, but also several standard electrical units. These are vital contributions if not particularly sexy ones.

His everlasting fame was in the end attributable to his pursuit of the laying of telegraphic cables, especially across the Atlantic. It was his persistence and ultimate success in this effort that led to his title, (The Queen was grateful for the vital contribution made by the overseas telegraph to holding the Empire together). His title was chosen from that of a small river near Cambridge, now immortalized in the absolute temperature scale.

The full title of Lindley's book is "Degrees Kelvin, a Tale of Genius, Invention, and Tragedy". The "Tragedy" relates to his later years, when his stubbornness in acquiring wrong-headed ideas very nearly cancelled out his early reputation. He had always been enamored by models—he kept dreaming up mechanical schemes that would explain electromagnetic phenomena. He developed similar fantasies to explain atomic structure. None of these ideas have survived. And famously he was done in by his underestimation of the age of the Earth. Surely here is an object lesson to the physicists who think they have it right. In fact he did have it right. His classical calculations of heat loss might not have been far off, except of course that he neglected the possibility of an internal heat source.

As a book that gives pleasure to the reader I recommend it highly. Its weakness, maybe not the fault of the author, is that, written only in words without any quantitative description of actual physics, I found it somewhat frustrating. I would have liked to

have been guided more carefully through Kelvin's early thinking, especially about heat and thermodynamics. Here is a subject whom the great scientists of the Eighteenth and Nineteenth centuries probed, ultimately successfully, squeezing blood from a stone, you might say, since the edifice of thermodynamics owed more to intellectual achievement than to the precise knowledge of how microscopic systems actually behaved. Lindley's discussions of these magnificent accomplishments mainly talked around, rather than through, the important concepts. The interplay of these masters, Clausius, Maxwell, Rayleigh, Carnot, Helmholtz, to name a few, and Kelvin's interactions with them, is for sure a fascinating tale. The book is, in the end, more about the personal Kelvin, his life, his quirks, and his substantial accomplishments, than it is a history of the development of thermodynamics, and Lindley cannot be faulted for this. Readers will have to go elsewhere for deeper treatments.

Still, I guarantee that you will enjoy this book, which not only thoroughly explores his life but offers as well a brilliant picture of the physics world of the late Nineteenth and very early Twentieth century

A minor observation: you need a scorecard to keep track of all the Thomsons, related and unrelated to William. I counted fifteen of them in the index, as well as one Thompson.

**REPORT OF THE SECRETARY-TREASURER by Harry Lustig**

***Editor's Note: with this report Dr. Lustig has resigned his position as Secretary-Treasurer. He is being temporarily replaced by Kenneth Ford, pending election of a new permanent Secretary-Treasurer.***

This report deals mainly with the financial aspects of the job. Other duties include keeping the records of our Forum, including membership lists and statistics, and minutes of the Executive Committee meetings, conducting the annual elections, acting as liaison between the Forum and the APS officers and keeping up the Web page where much information about FHP can be found at (<http://www.aps.org>); click on APS Units, Forum Homepages, History of Physics (FHP).

**Calendar Year 2004**

Our regular income comes from the following sources:

1) A “capitation” allocation from APS for each FHP member. In 2004 this will amount to about \$12,400. Membership in FHP is free for all APS members (and not available for persons who are not members of APS), except for those who already belong to two or more forums., for whom the annual charge is \$7.

2) FHP’s share of APS’ revenue for the March and April meetings, which is based on the number of contributed paper sessions that are organized by us. For 2004 this income amounted to about \$1156. By special dispensation of the APS Council, members may give a “technical” as well as a history talk at each meeting. Individuals who are not members of APS may give a talk if they are sponsored by a member. Further information about submitting abstracts for history talks may be found in this Newsletter in the article “Call for Contributed Papers”.

3) The Forum (and every unit of APS) receives interest at 7% annually on its assets held and invested by APS. At the beginning of 2004, this balance was \$14,425. Because during the year, expenses will progressively exceed income, I estimate that at the end, our balance will be \$11,000. Total investment income for 2004 will amount to about \$1300.

An anonymous donor has generously made a personal contribution of \$5000 “in honor of the newsletters’ excellent current and past editors”. This donor has also pledged to contribute equal amounts in 2005 and 2006. I therefore project that the total income for 2004 will be \$19,900.

The greatest single recurring expense is the Newsletter. Each of the two annual issues, if they are printed and mailed to the membership, costs at least \$5000.

A second expense arises from the need to pay for the travel expenses of some invited speakers which for 2004 amounted to \$3598. Miscellaneous expenses, estimated this year to be about \$1400.

The sum of these items is \$22,252. The net loss for 2004 is thus projected at \$2353 and the assets that will be carried over to 2005 are estimated to amount to \$12,072.

#### **Calendar Year 2005**

2005 is the World Year of Physics, in observation of the 100th anniversary of Einstein’s “miracle year” 1905. (See the article on APS activities). All over the world the achievements in physics of the last 100 years will be celebrated. While in a number of venues the emphasis will be on Einstein’s work and the work of those who have stood on his shoulders, there will also be explications of other events and developments in physics during the century and of the historical milieu in which they took place.

We have therefore resolved to make 2005 our miracle year, by substantially expanding FHP’s normal programs. (The miracle may well be stretching our resources to pay for the programs.)

As Robert Romer reports in this issue there will be three invited papers sessions on the theme “Einstein and Friends” alone. Some of the speakers will come from Europe. In order to be able to afford them and the larger than normal number of talks the anonymous donor has also pledged to donate up to \$5000; at this time I am budgeting half of that amount, in the hope that it will suffice. Furthermore, for the first time in its history, I believe, FHP has, with the approval of the APS Council, instituted “named lectures”: a donor will be able to name an invited talk after a deceased physicist. In 2005 there will be two such talks. One, which was solicited by our vice-chair, Virginia Trimble, will be sponsored by the Goldhaber family in memory of Gertrude Scharff-Goldhaber. The second, thanks to a \$1000 donation by Bob Romer, our chair-elect, will honor his mentor, Robert H. Dicke. Permanent guidelines for the solicitation and acceptance of funds for

“named lectures” will be discussed and decided by the FHP Executive Committee at its April 2005 meeting.

In order to accommodate and encourage such donations, as well as help support other FHP programs, we have set up an “FHP Special Programs Fund” in the APS office. We hope that many of you will consider contributing to this fund. Please send your unrestricted contributions (which are, of course, tax-deductible) to Darlene Logan, Director of Development, The American Physical Society, One Physics Ellipse College Park, MD 20740-3844, Phone (301) 209-3224, Fax (301) 209-0867; E-mail logan@aps.org. If you have a suggestion for a named lecture, or an inquiry, please contact any FHP officer. Guidelines for accepting and using such donations will also be on the agenda.

Finally, we have an opportunity to undertake two special outreach programs in 2005. APS has offered us \$2000 as contributions for the travel of history of physics speakers at undergraduate colleges. Institutions that will normally have the opportunity to hear these talks will receive preference. APS will also pay up to \$500 for the expenses of history speakers at meetings of each of the eight geographical sections, because they attract large numbers of graduate and undergraduate students. Virginia Trimble is in charge of both “match-up” programs and has or can point you to a growing list of speakers and topics. Because of the contingent nature of the programs and because APS will probably pay the expenses directly, they are also omitted from the FHP 2005 budget.

In sum, our income estimate from all sources for 2005 is \$22,370; our expense estimate is \$26,300; these will result in a net asset carryover to 2006 of \$8102.