APS NEWS

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APS Launches New Mass Media Fellowship Program

The APS is accepting applications for the first recipients of its Mass Media Fellowships, to be awarded in early 1997. In affiliation with the popular program instituted by the American Association for the Advancement of Science, the Society will sponsor two 10-week fellowships for physics students to work full-time over the summer as reporters, researchers and production assistants in mass media organizations across the nation.

The purpose of the program is to improve public understanding and appreciation of science and technology and to sharpen the ability of the fellows to communicate complex technical issues to non-specialists. It was proposed by Natalia Meshkov, past Secretary-Treasurer of the APS Forum on Education (FED), in conjunction with FED member and APS Councillor James Wynne (IBM/T.J. Watson Research Center) and FED Past-Chair, Ruth Howe (Ball State University). "The APS Forum on Education has focused its attention on programs to educate the public — both students of physics and adults," said Meshkov. "Ultimately, we decided to have physicists join the ranks of science reporters, at least temporarily, through a short-term fellowship program."

The Mass Media Science and Engineering Fellowship Program has been in existence for 21 years, and has placed approximately 350 fellows with news magazines, newspapers, TV networks and many local media organizations. About half of those fellows returned to traditional science and engineering careers, while the other half have since made careers in the mass media.

Graduate students, outstanding advanced undergraduates, and postdocs in physics or a related field are eligible to apply. The deadline for applications is January 15, 1997. See page 7 for details.

APS Electronic Journals and Services Come Online

APS is pleased to announce the availability of the following electronic products and services [For further information go to the APS h ome page at http:/www.aps.org under the Journals Information button]:

Physical Review B Rapid Communications-online
Launched on 1 July 1996, *PRB Rapids-online* is available free of charge to APS members who have a fiscal year 1997 subscription to any part of *PRB*. For further information please see http://publish.aps.org/PRBO/prbohome.html.

Physical Review C-online
Launched on 1 July 1996, *PRC-online* is available free of charge to APS members who have a fiscal year 1997 subscription to any part of *PRC*. For further information please see http://publish.aps.org/prcintro.html.

Physical Review D-online
Launched in its beta version on 1 August 1996, *PRD-online* is accessible free of charge to institutions and individuals through 31 December 1996.

Please note that there is no hard copy subscription requirement to access the beta version of *PRD-online*. For further information please see http://publish.aps.org/PRDO/prdohome.html.

Physical Review Letters-online
Launched on 1 July 1995, *PRL-online* is available on a subscription basis. Further information may be obtained from http://publish.aps.org/PRLO/members.html.

Physical Review Letters 1995 CD-ROM
PRL 1995 CD-ROM is now available. The price for APS members is $25 for U.S. orders, $30 elsewhere. The CD-ROM was included with the 1995 institutional subscriptions. Members wishing to place an order should contact the Membership Department, email: membership@aps.org.

E-Print Server
The American Physical Society launched the beta version of its *E-Print Server* on 1 July 1996. Its purpose is to enhance communication in the physics community at large. Authors wishing to submit materials can obtain further information at http://aps.publish.org/artintro.html.

Institutional Subscribers
For further information contact the Associate Publisher, The American Physical Society, One Physics Ellipse, College Park, MD 20740-3844 USA; fax: (301) 209-0844; email: assocpub@aps.org.

Judy Franz, APS Executive Officer, presents Prof. Hans Bethe, 90 years young, with a birthday card at a party in his honor on July 2 at Cornell University. The establishment of the APS Hans A. Bethe Prize was officially announced by representatives of the Divisions of Nuclear Physics and Astrophysics.

1996 Fall Meeting Madness

No fewer than nine APS units — four divisions and five geographical sections — are holding their fall meetings in the months of October and November, making it one of the busiest times of the year for the Society. The APS is also sponsoring the 49th Annual Gaseous Electronics Conference, 20-24 October at Argonne National Laboratory, focusing on basic phenomena and plasma processes in ionized gases, as well as the relevant theory and measurement of basic atomic and molecular collision processes.

OCTOBER 1996

2-5	Division of Nuclear Physics	Cambridge, MA
10-12	Texas Section	Arlington, TX
11-12	New York State Section	Ithaca, NY
18-19	New England Section	Burlington, VT
20-25	Division of Laser Science	Rochester, NY
20-24	Gaseous Electronics Conference	Argonne, IL

NOVEMBER 1996

1-2	Ohio Section	Athens, OH
11-15	Division of Plasma Physics	Denver, CO
14-16	Southeastern Section	Decatur, GA
24-26	Division of Fluid Dynamics	Syracuse, NY

IN THIS ISSUE

Our Apologies...

APS is converting to a new integrated software system, and in the process some members have experienced lapses in publications or a slower than usual processing time for renewals. Please accept our sincerest apologies if you have been affected. We are doing our best to clean up any lingering problems and appreciate your patience during this trying time!

APS Membership Department
Mary Pat, Trish, Joe, Fran, Ray, Leslie, and Alix

In His Own Words: Liu Gang: A Story of Physics and Freedom in China

Editor's Note: On the afternoon of 19 May 1996, K.C. Hsieh, a representative of the APS Committee on International Freedom of Scientists (CIFS), interviewed the former imprisoned physics graduate student, Liu Gang. The two-and-a-half hour interview took place in the office of Prof. Fang Li-zhi, Department of Physics at the University of Arizona. Fang Li-zhi, 1996 recipient of the APS Nicholson Medal, is a former chair of CIFS and a dissident from China. Notes of the interview, supplemented by material previously published about Liu Gang, served as the basis for the first -person narrative presented below.

Early Involvement

My involvement with the democracy movement in China began in 1984, when I was a graduate student in physics at Beijing University. Students in physics were particularly active in the movement for democracy and freedom. In 1986, I was arrested with 30 others for publicly displaying articles on democracy. We were released the next day after students from Beijing University staged a demonstration.

After graduating in 1987, I joined and organized several intellectual gatherings in Beijing. For example, in 1988, during the People's Congress, we pleaded in front of the motorcade of the People's Representatives for an increase in the national budget for education and for better treatment of intellectuals. Because of my involvement in these activities, I became a target of police surveillance and harassment.

Tiananmen Square, 1989

I entered Tiananmen Square on 20 April 1989, and between 23 April and 4 May, I played a central role in the activities on the Square. We were rational, peaceful, and non-violent, as demonstrated by the rally on 27 April, the largest ever to openly challenge the Communist Party. In fear of violent suppression from the government, I was against the hunger strike in May and in favor of ending the occupation of the Square by 31 May. My efforts failed, and so I left the Square on 30 May. I was not at Tiananmen Square when the massacre occurred. The order for arrests came on 12 June 1989, and I was captured at about 7:00 PM on 19 June in a park near the Baoding Railway Station. The interrogation, with a gun pointing at my temple, lasted the whole night. Since other people's railway tickets were found on me, I was forced to reveal their identities at gun point.

Trial

While under investigation without charge, I was in Beijing's Qincheng Prison from 19 June until the end of 1989. Three days before the pretrial, I was allowed to get a lawyer for this proceeding. My younger brother found me a lawyer, who met me once and insisted that he could defend me only if I pleaded guilty, not only of the charges against me but also of those against my companions. I asked for another lawyer, but this was denied.

During the pretrial, I refused to answer any questions and insisted on my innocence. The judge asked me to cooperate, so that he could at least document that I showed signs of repentance. The government desperately needed an acknowledgment of guilt from me in order to extract confessions from the others who were being tried separately.

My trial took place on 12 February 1991, and lasted a little over an hour. There were no witnesses, only "confessions," read by the court, from others who were accused. The evidence presented consisted of police records showing my presence at meetings where subversive views were allegedly aired by others present. I remained silent. The judge, advised by a joint committee of policemen, the prosecutor, and the court, declared me guilty of sedition with the intent to overthrow the government, and sentenced me to six years of imprisonment. Immediately after, I appealed to the Beijing High Court, which upheld the previous ruling without any hearing.

Prison

I remained in Beijing's Qincheng Prison in solitary confinement until April 1991. On 22 April, 13 of us, all political prisoners, arrived at the Linoyuan No. 2 Labor Camp in my home town, where we were to undergo thought reform. Political prisoners were supervised by common criminals, who made us memorize the "Fifty-eight Rules for Reforming the Behavior of Criminals." Every day, each of us would be asked to recite aloud any number of the rules, forward and backward. For each mistake you received one beating.

On 29 May 1991, our group refused to take the exam, resulting in a three-month "strict discipline," during which our hands and feet were cuffed. Our refusal to repent was met with "electric treatment" or "bench sitting." The "electric treatment" is beating by an electric rod which gives you a painful jolt at each strike. The "bench sitting" is to sit motionless on a 10-cm wide wooden bench for fourteen hours every day. The beatings and the cuffs caused bruises and inflammations, but no medical treatment was given to us unless you showed signs of dying. On 15 November 1991, we held a hunger strike, which led to another three-month "strict discipline."

The only time I thought of dying was when I was chained and cuffed with my hands behind my back. The twisting of my body gave me an excruciating headache. I wanted to dash my head against the wall, but I was watched and prevented from hurting myself. This punishment lasted three days and three nights. During most of the jail time, however, I felt peace within me. I knew I was right. I never gave up hope. Victory eventually belongs to righteousness.

The Right to Survive

The period of pre-trial detention was counted as part of the six-year sentence, so I was released from Lingyuan Labor Camp on 18 June 1995, and was delivered directly to my parents' home in Liaoyuan. A special police force was assigned to watch over me 24 hours per day. A searchlight illuminated our house at night. Our home was searched several times, without reason or search warrant. Sometimes our telephone went dead in the middle of a conversation. The Post and Telecommunication Office, which provides all telephone services, told us that they were instructed by the police not to do any repair work on our telephone. The Post Office refused to mail my letters.

Police harassment went beyond my immediate family. Two of my cousins were snatched into a police car, immediately after they visited us, and rushed to the police station, where they were stripped and detained for five hours. Friends whom I visited were taken to the police station and reprimanded for having me in their home. Even a taxi driver had to surrender his license after giving me a ride.

Of course, there were rules I had to obey. I had to report weekly to the police about my thoughts. I had to live in my parents' house. I was not allowed to be employed in any public or private work unit. To make a living, I tried to obtain a license for opening a small bookstore. After four months of resubmitting my application, each time with additional required information, my request was denied.

The police of Liaoyuan took away

Liu Gang, 19 May 1996

my basic human right to survive. I was told to take my complaints to the Ministry of Public Safety. To my surprise, I got out of Liaoyuan on about 9 April without being noticed. In Beijing, I was able to see some of my friends. After I submitted my complaints to the Ministry of Public Safety on about 20 April, I noticed that I was being followed. I narrowly escaped the police. It was apparent that I could no longer stay in Beijing or any other place in China.

Physics and Dissent

I have read biographies of great scientists like Einstein, Galileo, and Madame Curie. I found their search for truth inspiring, their personal integrity admirable, and their scientific accomplishments beautiful. I believe that their spirit is rooted in their discipline as physicists. When I was an undergraduate at the University of Science and Technology, I took the courses taught by Prof. Fang Li-zhi and was fascinated by the subjects and his teaching. He taught us how to question things. He was the most popular teacher in physics. Later, we called him "Sakharov of China."

There was a disproportionate number of physicists among the dissidents. As I mentioned earlier, almost all the student movements in Beijing were started by physics students. Six of the 21 most-wanted student leaders are physicists. This phenomenon can be explained. Under Communist rule, education has been controlled by Marxist, Leninist and Maoist doctrines, especially in the social sciences. Even mathematics had to be learned according to Marx's notes.

Among all the disciplines, physics is least controllable by Communist ideology. People with an inquiring mind naturally take up physics as their major in the universities. Human creativity in the search for truth requires freedom.

CIFS and APS

It was on National Day, 1 October 1992, when my younger sister told me that there was a letter from the United States on my behalf. In 1993, she told me there was a petition signed by American physicists for my release and a letter inviting me to the United States. In the same year, I was told that my teacher, Prof. Li Shuxian spoke at the World Conference on Human Rights in Vienna and mentioned my case by name.

For awhile, I thought all that would lead to an early release. It didn't happen. However, I was treated much better after all the publicity. They stopped beating me. The police have some respect for scientists, and because so many scientists spoke out, they took this very seriously. Even the Chief Warden of No. 2 Labor Camp became afraid of me.

I am forever grateful to the efforts of CIFS, other human rights organizations, and caring individuals. Their letters and petitions gave me courage to survive and reduced police brutality to make my prison life more bearable.

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APS Supports Formation of ICSU Human Rights Monitoring Committee

At its June meeting, the APS Executive Board voted to support a May 21 letter from the American Association for the Advancement of Science (AAAS) to the International Council of Scientific Unions (ICSU), requesting the formation of a human rights commission within that organization, which would address the broader issue of scientific relations and human rights by monitoring the rights of scientists worldwide.

Richard Nicholson, executive officer of the AAAS, wrote in his letter. "We have found…that scientific associations' work on behalf of their colleagues whose rights have been violated presents a powerful tool for helping ensure that such abuses do not continue or recur."

Under the terms of the proposal, the ICSU commission would monitor compliance with Article 5 of the organization's statutes, particularly the principle of "…freedom of association, expression, information, communication and movement in connection with international scientific activities, without any discrimination on the basis of such factors as citizenship, religion, creed, political stance, ethnic origin, race, color, language, age or sex." Documented violations would be reported to ICSU's member scientific unions, national academies, and national research councils, and would then be handled according to the rules of each member organization.

The proposal arose from discussions between the APS Committee on International Freedom of Scientists (CIFS) and the APS Committee on International Scientific Affairs (CISA). The APS committees joined forces with the AAAS to draft the proposal to ICSU.

NSF's GOALI Program Promotes Industrial/Academic Partnerships

As part of its objective to improve the nation's capacity for intellectual and economic growth, the National Science Foundation (NSF) offers a program that aims to synergize industry-university partnerships by making investment funds available to support an eclectic mix of industry/university linkages. In the program's first year alone, approximately $4 million in awards were made, and the award funds are expected to increase in 1996 and 1997.

Known as Grant Opportunities for Academic Liaison with Industry (GOALI), the program targets high risk and high gain research with focus on fundamental topics that would not have been undertaken by industry; development of innovative, collaborative industry/university collaborative programs; and direct transfer of new knowledge between academia and industry. It specifically focuses on affording the opportunity for faculty, postdoctoral fellows, and students to conduct research and gain experience with production processes in an industrial setting.

Funding is provided to develop creative modes of collaborative interactions with industry through individual or small group projects, and for industry-based fellowships for graduate students and postdoctoral fellows. Examples of GOALI mechanisms include the following:

- extended faculty visits to industry (three to 12 months) to foster long-term industry/university collaboration;
- faculty visits to industry (two to six months) at the beginning of a three-year university-based research project with the intention of transferring results to industry by the project's end;
- university-based support for cooperative university and industry engineers and/or scientists on research projects of mutual interest;
- support for interdisciplinary research/educational projects for two or three faculty from different academic units to interact with one or more industrial partners in a "virtual industry/university group"; and
- visits to universities by leading industrial engineers, scientists and managers to catalyze collaborative research and/or teach and develop curricula.

Those interested in more information about the GOALI program should contact Dr. Robert Reynik, who is handling inquiries for all fields within the NSF directorate for Mathematical and Physical Science (MPS), 4201 Wilson Blvd., Rm 1065S, Arlington, VA 22230, email: rreynik@nsf.gov, phone: (703) 306-1814. Details of GOALI can be found on the OMA home page at http://www.nsf.gov:80/mps/oma. There are currently no target dates.

Hansch to Receive Schawlow Prize at DLS Meeting

Theodor W. Hansch, executive director of the Max Planck Institute for Quantum Optics in Garching, Germany, will be awarded the 1996 Arthur L. Schawlow Prize in Laser Science during the APS Division of Laser Physics ILS-XII meeting, to be held 20-25 October 1996 in Rochester, New York. Sponsored by the NEC Corporation, the prize is intended to recognize outstanding contributions to basic research that uses lasers to advance knowledge of the fundamental physical properties of materials and their interaction with light.

Hansch's citation reads, "For his many outstanding contributions to laser spectroscopy including his extraordinary measurement of the spectrum of atomic hydrogen."

Hansch received his Ph.D. from the University of Heidelberg in 1969 and came to the U.S. the following year. He joined the faculty of Stanford University in 1972, where he remained until returning to Germany in 1985. His research interests include testing basic physics laws with techniques of precise laser spectroscopy and the cooling and manipulation of atomic matter with laser light. He is a past recipient of the APS Herbert P. Broida Prize (1983).

Hansch's first major work was the development of the first useful narrowband tunable dye laser, which is still a standard tool in many laboratories worldwide 20 years later. Over the years he has invented or developed many new spectroscopic techniques using this laser, effectively ushering in the modern age of laser spectroscopy. He recently carried out the first investigations of the effects of phase on laser cooling, and has been a leader in the production and study of optical lattices.

However, Hansch's most important work has undoubtedly been his dedication to the spectroscopy of the hydrogen atom over the past 20 years. His work has resulted in tremendous improvement in the resolution with which hydrogen atoms are now measured. He has measured the Rydberg constant far more accurately than any other fundamental constant is known, and his hydrogen spectra now provide among the most precise tests of QED corrections.

IN BRIEF

- The APS Division of Laser Science (DLS) selected five new speakers for its Distinguished Traveling Lecturer Program, intended to bring distinguished scientists to predominantly undergraduate colleges and universities. Lecturers for the 1996-1997 academic year and their topics are Geraldine Richmond (University of Oregon) on surface nonlinear optics; Jagdeep Shah (AT&T Bell Laboratories) on quantum optics; Stephen Leone (JILA/University of Colorado) on chemical physics; Philip Bucksbaum (University of Michigan) on high-field laser physics; and Bill Phillips (NIST) on atom cooling and trapping. Lecturers will visit selected academic institutions for two days, during which time they will give a public lecture open to the entire academic community, and meet informally with students and faculty. They may also give guest lectures in classes related to laser science. Priority in site selection is generally given to institutions that are not located in major metropolitan centers and do not have extensive resources for similar programs.

- The State Council of Higher Education for Virginia recently appointed a committee to review the state's public undergraduate and graduate physics programs. The review was prompted by the serious challenges and changing opportunities being faced by physics departments in enrollment, curriculum and funding, and by physics graduates in employment and career choices. A task force consisting of in-state and outside physicists from academia, government and industry — including APS Executive Officer Judy Franz and APS consultant Brian Schwartz— issued a report in July, in which they developed a series of five major recommendations to preserve and strengthen the physics program, as well as to create strategies to identify and take advantage of new opportunities. Copies of the report, including an executive summary and a list of recommendations with background and other supporting materials, are available on the World Wide Web at http://www.schev.edu/wuacadpg/physics.html.

- In July, President Clinton selected three physicists among the eight scientists and engineers nominated to serve on the prestigious National Science Board (NSB), an advisory body to the National Science Foundation. The physicists nominated are: John Armstrong, former vice president of science and technology at IBM and a fellow of the APS; Mary K. Gaillard, Professor of Physics, UC Berkeley who is also an APS fellow; and Vera Rubin, a research astronomer with the Department of Terrestrial Magnetism of the Carnegie Institution of Washington who received the President's National Medal of Science in 1993. The Board was established in 1950 and has 24 members serving six-year rotating terms. They are selected for their distinguished service in research, education, or public service.

  The other five new NSB nominees are: M.R.C. Greenwood, former associate director for science in the White House Office of Science and Technology Policy (see Back Page, October 1994 APS News); Stanley Vincent Jaskolski, chief technical officer and vice president of technical management for the Eaton Corporation in Cleveland, Ohio, who will become president of the Industrial Research Institute in May 1997; Eamon M. Kelly; Bob H. Suzuki, president of California Polytechnic University; and Dr. Richard Tapia. In their capacity as NSB members, these candidates will recommend overall national policies for promoting basic research and education in the sciences to the NSF. Their terms will expire in May, 2002.

- The recipient of the 1996 Doctoral Thesis Award for Atomic, Molecular and Optical Physics was chosen in May. Aephraim M. Steinberg, University of Toronto, will receive $1000 for his thesis, entitled "The Single-Photon Tunneling Time and its Sub-Femtosecond Measurement via Quantum Interference." Chaired by Philip Cosby of SRI International, the selection committee chose Steinberg from among five finalists who presented their work orally in a special invited paper session at the 1996 APS Spring Meeting in Indianapolis, Indiana. The award was established in 1992 by the Division of Atomic, Molecular and Optical Physics to recognize doctoral thesis research of outstanding quality and achievement in atomic, molecular or optical physics, and to encourage effective written and oral presentation of research results.

- In July, President Clinton announced a research contract to build the world's fastest and largest supercomputer at the Department of Energy's Lawrence Livermore National Laboratory in California. The new supercomputer will be 300 times more powerful than any in the world. Built in partnership with the DOE and IBM at a cost of about $93 million, the supercomputer is expected to go online in 1998.

OPINION

APS VIEWS

Why APS Should Support CIFS as a Standing Committee

by Gregory A. Loew, Chair, APS Committee on International Freedom of Scientists

The question of why the APS should support the Committee on the International Freedom of Scientists (CIFS) as a standing committee is not a trivial one, and it is frequently asked, especially in times of tight budgets. As 1996 Chair of CIFS, I feel compelled to share my thoughts on this matter with our membership.

CIFS is a standing committee of the APS charged with monitoring the human rights conditions of physicists and other fellow scientists, and advocating for their freedom when it is threatened. According to its charge, "CIFS shall be responsible for monitoring concerns regarding human rights for scientists throughout the world; shall apprise the President, the Executive Board and Council of problems encountered by scientists in pursuit of their scientific interests or in effecting satisfactory communications with other scientists and may recommend to the President, the Executive Board and Council appropriate courses of action designed to alleviate such problems."

The committee was created in 1980 as an outgrowth of a POPA subcommittee. It was felt at the time that POPA by itself did not have the structure, time and resources to attend to human rights issues. CIFS functions with a Chair, Past-Chair, Vice-Chair and approximately eight volunteer members from various institutions throughout the U.S. Although CIFS formally meets only twice a year, it monitors, at all times, the human rights conditions of a multitude of scientists in the U.S. and worldwide.

When a case is brought to the committee's attention, the first step is to decide whether the scientist is truly a victim of discrimination and/or persecution. Since this is often not clear, CIFS sometimes begins by requesting information from the pertinent authorities, without taking a stand. This step alone has resulted in favorable action in some cases. In general, CIFS stays away from questions of tenure that are more appropriately handled elsewhere, unless these are related to issues of academic or scientific freedom or other such violations of due process of law. In countries other than the U.S. that enjoy democratic regimes, we sometimes consult first with the applicable domestic physical society to check whether it is aware of the case and has already assessed the issue at hand.

Once we have gone through these initial steps and determined that the scientist's situation falls within the Committee's guidelines for assistance, we then write letters of support for the individual and try to elicit answers from those organizations that have some control over his or her fate. In extreme cases where the individual is in physical danger, in jail or even tortured, official APS letters and petitions are sent to heads of state. At the early informational stages, the letter is signed by the CIFS Chair. When appropriate, the letter goes out with the signature of the APS President.

Two valid questions arise: (1) Why does APS take on such an activity, rather than just leaving it to specialized organizations such as, for example, Amnesty International? (2) Is CIFS successful? The two questions are linked. Historically, physicists and scientists in general, because of their contributions to knowledge and technology, have occasionally become well-known and held influential positions in society. Some of them have been mistreated or persecuted, simply because they belonged to some minority group against which discrimination already existed in general. Others, because of their prominence and occasionally their courage in opposing the status quo or refusing to support a regime that they deemed undemocratic and repressive, have taken great political risks, and some of them have ended in jail, exile and/or torture. The greater their moral courage, the harsher their punishment, but also the stronger their influence, and their ultimate chance of redress. We do not have to go very far back in history to remember Andrei Sakharov, Yuri Orlov, Anatoly Sharansky, Fang Li-zhi, and the Chinese physics student, Liu Gang who recently escaped from his country (see page 2). But we should not feel too self-righteous and smug in our traditionally democratic countries. We are not perfect either: just remember the McCarthy era!

But is CIFS effective? The answer is yes, and the reason is that we try to be objective and firm. Physicists all over the world are at the forefront of international communication, and most of them enjoy an intrinsic camaraderie and loyalty to their common field of endeavor. They like to work across national boundaries and collaborate on interesting problems. Statesmen and politicians know of our camaraderie, and in general they respect what we have to offer. So, if we behave ourselves objectively, we have some clout as a group and we can help our colleagues in distress. We get ample feedback in response to our advocacy. Even if CIFS members cannot prove that by ourselves, we have saved certain colleagues from jail, we know that our voice, alone, has helped many of them and in some cases has softened the punishment they received from their authorities.

With volunteers doing most of the committee's work and a small budget able to provide for only two one-day annual membership meetings, I firmly believe that this is a very cost effective and worthwhile cause. From a human point of view, it is a tradition that constitutes part of the conscience of our society. It is an opportunity for us physicists to do something in a constructive direction. We should not miss it. I hope I have convinced you to continue to support CIFS and to actively join us in the pursuit of this cause.

Gregory A. Loew is a professor and physicist at Stanford Linear Accelerator Center.

LETTERS

Don't Put Up Barriers to Foreign Students

I am responding to the letters on foreign physics students published in the July 1996 issue of *APS News*. The free-marketeer's stance on the bumper crop of physicists is: if the U.S. ejects all its educated foreign nationals, or stops letting outsiders in at all, then instead of importing some employees, U.S. commerce will more vigorously export workplaces. But this will take a long time.

An argument against putting up barriers to foreign grad students that immediately benefits native-born students also exists. U.S. students benefit from the job-hunting advice of their foreign-born fellows. Speaking for myself, I found talking with newly-employed Ph.D.s whose temporary visas forced them to be extremely resourceful about looking for work to be helpful during my own recent job search. I suspect that there would be many fewer jobs available for physicists outside of physics right now were it not for the reputation that physicists (often foreign-born) have established outside of physics, often by obtaining a second degree in another field while earning a physics Ph.D.

Mr. Moodenbaugh's statement that U.S. nationals are "restricted" to the U.S. job market while foreigners are not is perplexing. First, Americans are not so restricted. Many European countries have special funds for foreign postdocs, and there are opportunities in Japan also. Second, a temporary visa imposes a disadvantage to U.S. job-hunting, a fact which may not be unrelated to the larger fraction of foreign nationals choosing postdocs over permanent work.

If there is a problem of oversupply of physicists the solution might be found by imposing some sort of accreditation program to limit the number of Ph.D. granting institutions. I don't know if the disease is serious enough to warrant so drastic a cure.

Lukas Wagner
Columbus, Ohio

A Contrasting View of Standardized Tests

The article "Fighting the Gender Gap," in the July 1996 issue of *APS News*, is shamelessly one-sided. Arguments in favor of standardized tests are barely mentioned, but Pamela Zappardino, executive director of FairTest, a group that opposes standardized tests, is quoted extensively. Let me cite several distortions and instances of sloppy reasoning.

Ms. Zappardino states that the SAT accounts for at best 16 percent of the covariance in freshman college grades and is therefore a poor predictor. This is quite misleading, because of the "restriction in range" effect. A very selective institution admits students with almost uniformly high SAT scores. The fact that SAT scores correlate only modestly with grades in THAT group does NOT mean that students with much lower test scores would do well.

The article mentions that girls' scores improve when a test is not timed, while boys' scores change very little. So what? In the real world, people must solve problems under time constraints. There are few exams in college or graduate school where time is unlimited.

It is stated that foreign students do well on the GRE subject test, "although their performance in graduate school isn't any better or worse than their American colleagues." It is not stated how "performance in graduate school" is defined. At the University of Illinois at Urbana Champaign, where I am a graduate student in physics, foreign graduate students are much more likely than Americans to pass the qualifying exam at the "free shot" immediately upon entry. The qual exam is not multiple choice and allows ample time for completion, but the superior performance of foreigners on the timed, multiple-choice GRE seems to carry over.

A female physicist states that she needed to learn standardized test skills, not physics, in order to get an adequate score on the GRE physics exam. To prepare for the physics GRE subject exam, I simply reviewed the syllabus of the test and earned a very good score. This is just an anecdote, but so is her story.

Professor Georgi of Harvard says that standardized tests favor "idiot savants." He cites as evidence for this extravagant claim the cases of two female undergraduates he knew. He forgets that one should not generalize based on a sample size of two.

It is reported that Harvard's graduate admissions committee relies more heavily on letters of recommendation and the personal essay than the GRE in making decisions. Has the committee calculated the correlation coefficients of these measures with first-year graduate student grades or completion of the Ph.D. degree? Critics of standardized tests never bother to demonstrate with hard numbers that the admissions criteria they prefer do a better job. How can one compare students from different schools, much less different countries, without standardized tests?

The final quote from the anti-test lobbying group notes that the number of colleges not requiring standardized tests has grown. Admissions directors may decide to drop the SAT for reasons other than validity — it is good for one's ego to believe that one is making a decision that cannot reduced to "mere numbers".

The differences in boys' and girls' SAT scores is small, but the differences among ethnic groups are substantial. The consequences of this differential have been studied, but none of this research find its way into *APS News*.

The SAT does not underpredict the academic performance of blacks in college — in fact, it is a better predictor than high school grades (Thomas Sowell, Inside American Education, p. 128). Admitted black students to MIT have scored in the 90th percentile nationwide on the math SAT, but in only the 10th percentile among MIT students. Nearly 25 percent of these students

OPINION

Leaving Science Can Be a Good Career Decision

by Wolfgang Hierse

Many young scientists are struggling to find employment in their field of training. As a young Ph.D. physicist, I know the situation. However, did you ever consider that there are reasons why you SHOULD get out of science, and that there is little reason to be unhappy about it? Let me tell you about my personal perspective on this and how I found a job.

Like many of my university pals, I entered physics because at that time, I felt very strongly that physics is "where the future is made." I wanted to be part of the exciting developments that would shape the next century. Well, what I found is not a place where the future is made, but an industry badly in need of restructuring and, yes, downsizing.

Modern science is fascinating. Much of it is also absurdly over-specialized and badly out of touch with real-world problem and needs. Most results are neither marketable outside science, nor even communicable to more than some 100 people on the globe at any given time. In my view, this is the real cause for the present dismal funding situation. Make no mistake about economic factors and hostility against science: nobody would dare touch science if it were obvious that science generates solutions to society's most pressing problems. Unfortunately, taking society's problems more seriously than personal inclinations would be a tremendous mental step for the average researcher. The situation will probably be resolved differently. The scientific establishment will not change its attitude. On the other hand, young researchers will be forced to leave until science has shrunk to a size commensurate with its perceived usefulness or political clout.

For most of us, there will be no well-paying, secure job in basic research. There will be no way to pursue your hobby regardless of accountability, and get paid for it. If that was your dream, that's sad. But then, this dreamt-of position is a thing of the past, a privilege that really shouldn't be there, except for a few absolute geniuses. However, if your goal in life is to do something useful, what are you unhappy about? Science is not about employment, or tenure, or grants and funding. It is not about being allowed to do what you like. It is not even about your personal little happiness, but about doing what you feel MUST be done. Science means generating and using knowledge to solve problems. In this way, being a scientist is not something that anybody can take away from you. If you tackle problems nobody has solved yet, if you do whatever it takes to solve them, if you believe in the power of reason, you are a scientist.

In contrast to what one might have expected in the 60's, the problems of the 21st century will not be the colonization of the solar system but rather reducing environmental pollution, controlling population growth and coping with the depletion of natural resources. While traditional scientific research will help solve these problems, it is fairly clear that the good old scientific discovery alone won't do the trick anymore. Most of our major ills are not primarily due to the lack of scientific and technological knowledge. The technology is there to feed and house everybody on the planet. The actual problem is within our heads, not so much in the tools we hold in our hands. The success of science and rational problem solving will not be determined by abstract insights but by the number of people that you can convince to go along with you.

My three-month job search resulted in three offers from management consulting firms, one offer of a computer-oriented job at a major chemical firm, and one temporary post-doc position at a company producing scientific software. I chose to join the consulting firm McKinsey last August. It seems to me that these people care about the right problems. I also have the somewhat disturbing impression that what they are doing is actually science in a way — the way it should be.

Wolfgang Hierse is with McKinsey & Co., Germany.

Letters *(continued)*

failed to graduate (p. 144). At Berkeley, only 22 percent of Hispanic students preferentially admitted had graduated five years later, while more than half of those admitted under normal academic standards had graduated.

Before making self-righteous statements about the need for ethnic "diversity" in physics, one should estimate the pool of "under-represented minority" students qualified to major in physics in college. In 1985, the number of American Indian, Black, Mexican American, and Puerto Rican students scoring above 600 on the math SAT, was 3,929, compared to 11,903 Asian Americans (p. 142).

Physicists say that the critical thinking skills developed by training in physics will carry over to other fields. The essays published on "diversity" in *APS News* do not support this claim.

Vivek Rao
University of Illinois

GRE Scores Serve a Purpose

With regard to the article on gender bias in the GREs (*APS News*, July 1996), I agree with the opinion that the GRE should not be used to keep capable students out of graduate school. However, the GRE has a more positive function: It allows students from unknown schools to compete for positions in graduate school. The problem with letters of recommendation from unknown professors is calibration. If I say "This is the best student I've seen in ten years," it helps the student if the GRE scores verify and quantify that statement.

John W. Dooley
Millersville University

Straight (Back) Talk

We must bow to Francis Slakey ("Straight Talk," *APS News*, Aug./Sept. 1996), who could perfect his writing style by mere improvements in word choice and sentence length. The rest of us, brought up on television scripts, e-mail, and writings of the technically precocious but incompletely educated, have to start much further back. We must learn the many basics that were kept from us in the formative years of grades K-6, such as that split infinitives are not necessarily incorrect but are necessarily inelegant; that a gerund requires the possessive case; and that agenda, bacteria, criteria, and data ARE PLURAL. When the bricks and mortar of language are missing, the perfecting of its beautiful architecture will have to come later. Staffing technical publications with well-read, vigilant copy editors would be a big help.

Fred Ordway
Bethesda, Maryland

Z's Fight Back

This letter is a comment on your "Straight Talk" article in the Aug/Sept issue of *APS News*. Although I found myself in agreement with most of it, I must say that, for obvious reasons, I am totally opposed to the proposal to drop the letter "Z" from the alphabet.

In fact, I have believed for some time that the order of the alphabet should be revised, and should start "zabcde…".

Neil Zimmerman
NIST, MD

An Age-Old Question…

Your report on Don Vandenberg's new data on the age of globular clusters left me somewhat confused ("New Cluster Data Puts Universe at 13 Billion Years," *APS News*, July 1996). I do not understand why "the universe cannot be older than its older stars," as stated in the article. For instance, my Mom is older than I am. Likewise, it would appear to me that the universe actually MUST be older than its older stars, but it cannot be any younger.

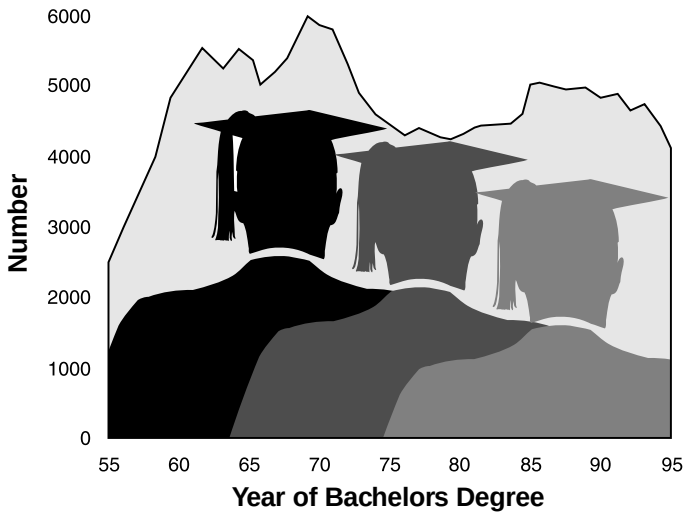
However, in the same way as my Mom may not delight in sharing how much older than I she is, so also the Universe is unwilling to easily let us know how much older than Population II stars it is. If I missed the point altogether, I would appreciate any clarifications you could provide to me.

Fabrizio Pinto
Portland State University

The Editor Responds:
As Professor Pinto noted in such a good humored way, we erred and the statement should have indicated the apparent paradox of the universe being younger than its oldest stars. This reminds me of the limerick: There once was a woman named Bright, whose speed was much faster than light; she eloped one day in a relative way, and conceived the previous night.

FACTOID

Physics Bachelors Production in the U.S., 1955 to 1995



The number of students obtaining bachelors degrees in physics continues to fall. There were 4,268 physics majors in the class of 1995, representing a 7.5% decline from the previous year. The cumulative drop in degrees over the last six years now stands at 15%. We expect the class of 1996 and 1997 to be smaller still, with degree production at levels not seen since the mid 1950s.

BOOK REVIEW

by Barrett Ripin, APS Associate Executive Officer

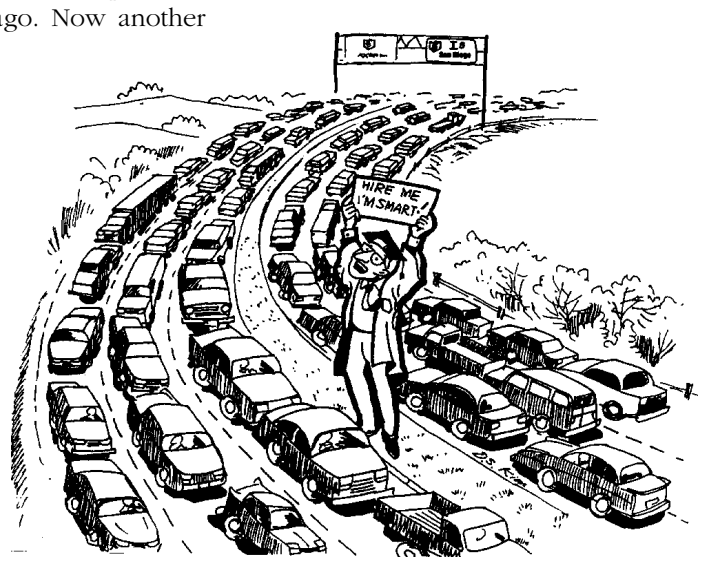
To Boldly Go: A Practical Career Guide for Scientists, by Peter S. Fiske [American Geophysical Union, Washington, DC, 1996. Single copies: $19.00 ($13.30 for AGU members); $10.45 for 10 or more copies.]

From an employer's perspective, REJECT is the easiest response to a job applicant. It is typically made within 20 seconds of picking up your resume and, in the current employer's market, it is by far the safest decision. Selecting you, on the other hand, is not only hard and stressful for an employer — it is very risky. If you don't work out, then two careers are damaged — yours and theirs. Somehow, in that first fraction of a minute you must differentiate yourself from the hoards. Then in the subsequent interview and visitation dance, you need to convince them that it would be big mistake not to go after you. If you don't understand this basic psychology then you will have lots of practice job searching.

Physics postdoc Kevin Aylesworth first clanged the employment problem alarm a few years ago. Now another postdoc has written the most practical and readable career and employment guide available. Peter Fiske's *To Boldly Go: A Practical Career Guide for Scientists* is chock full of useful advice and tips for both early- and mid-career physicists. It is about creating options, recognizing opportunities, and avoiding pitfalls. In 188 easy-to-read pages, Fiske's guide helps you chose which jobs to go after, backup strategies to your dream career, how to get past the first fatal 20 seconds, how to clinch the offer, and even how to negotiate favorable employment terms (salary). Fiske dispenses wisdom beyond his years with efficiency and good humor. It is best read twice: once well before active job seeking begins and again during the process.

Secure and content in your current position? Use or lend the guide to help out students, postdocs, family members, and less fortunate colleagues. [However, don't be too smug — I personally know several physicists who last year had no idea that they would be down-sized, RIF'd, or feel vulnerable this year.]

The guide would make a good beginning of a 'survival kit' for college seniors, graduate students, and postdocs. A worthwhile read for those who value being happily employed.



National Society of Hispanic Physicists Founded

The National Society of Hispanic Physicists (NSHP) was founded in May at a meeting held at the University of Texas, Austin (UTA). The founding meeting was attended by Richard Saenz, Chair of the APS Committee on Minorites, as well as representatives from the American Association for the Advancement of Science, the National Science Foundation, Exxon, IBM, and numerous universities. The new society's mission is to foster and support the participation of Hispanics in careers in physics.

According to co-founder David J. Ernst, associate dean of Vanderbilt University's College of Arts and Science, director of the Pan-American Association for Physics (PAAP) and Fellow of the APS, the Hispanic minority in the U.S. is extremely under-represented in the sciences and engineering. An Hispanic in the U.S. is only one-sixth as likely to receive a B.S. in science or engineering as a white non-Hispanic person; the ratio drops to one-twelfth if the Hispanic person is Mexican-American. Female Hispanics are even more under-represented than males.

"With the globalization of the economy, and especially the signing of NAFTA and other pending agreements with Latin America, the U.S. Hispanic community offers a unique opportunity to build a mutually beneficial economic alliance with Latin America," said Ernst. "However, an increased participation of the Hispanic community in business, and particularly high-tech business, is needed."

Even before its founding, the NSHP enrolled over 80 members through the efforts of the PAAP, and the membership is now about 100. Members need not be Hispanic, according to co-founder Carlos Ordonez, an APS member, UTA assistant professor and PAAP associate director. "There's no restriction except professional," he said. "Anyone who shares our goals will be welcome. We want to promote Hispanics, but we want to get them into mainstream society. We don't want to form a separate group. In science and technology we have to deal with all kinds of people."

PAAP will continue to provide basic support for the new society until it establishes its own operations. The project also received support from the Sloan Foundation, as well as the SBC Foundation, Clark Atlanta University's Center for Theoretical Studies of Physical Systems, Vanderbilt University, and HEB Grocery Company.

ANNOUNCEMENTS

APS Industrial Summer Intern Program - Summer 1997

Deadline: 25 October 1996

DESCRIPTION

The American Physical Society Industrial Summer Intern Program (ISIP) provides an opportunity for well-qualified physics students to spend time in an industrial environment during the summer months.

QUALIFICATIONS OF APPLICANTS

Any graduating college senior or first year graduate student majoring in physics may apply. Applicants should expect to spend the period June through August as an intern and to participate in existing projects in the host laboratory. Some laboratories may require U.S. citizenship. Since the program is competitive, applicants should have excellent academic records and a high degree of motivation, and should describe any research or technical experience they may have.

STIPEND

The stipend for interns will be about $2,000 per month, varying somewhat with each industrial company. Provision for relocation expenses and fringe benefits will be made according to the practice of each host laboratory.

SELECTION PROCEDURE

A review committee appointed by the APS President will screen all completed applications. Companies and laboratories will offer internships directly to the students whom they have selected from the pool. It is expected that offers will be made by mid-April 1997.

INDUSTRIAL ORGANIZATIONS

Industrial organizations interested in participating in ISIP are invited to contact the Program Administrator.

APPLICATION PROCEDURE

Applicants should complete and return the application form and arrange to have two letter-of-reference forms and the chairperson's endorsement form sent to the Program Administrator. Transcripts may be included with the application form or sent to the Program Administrator by the school. Completed applications and supporting material must be received by **25 October 1996**. **Copies of all forms are available in the Office of the Chairperson of your department or from the address below.**

FOR FURTHER INFORMATION

ISIP Program Administrator
Education Department
The American Physical Society
One Physics Ellipse
College Park, MD 20740-3844
(301) 209-3231/tara@aps.org

Applications for ISIP are also available on the Internet at http://aps.org/educ/intern/index.html

Nomination for DAMOP Thesis Award

Please refer to the APS Membership Directory, pages xxiii- xxxix, or the APS home page [http://www.aps.org] under the Prize, Award and Fellowship button, for complete information regarding rules and eligibility requirements.

1997 Outstanding Doctoral Thesis Award for Research In Atomic, Molecular, or Optical Physics

Endorsed by members and friends of the Division of Atomic, Molecular and Optical Physics.

Purpose: To recognize doctoral thesis research of outstanding quality and achievement in atomic, molecular, or optical physics and to encourage effective written and oral presentation of research results.

Nature: The Award to be given annually consists of $1,000 and a certificate citing the contribution made by the recipient. All finalists will receive a travel stipend of $250.

Send name of proposed candidate and supporting information before 15 November, 1996 to: Kenneth C. Kulander, Lawrence Livermore National Laboratory, PO Box 808; L-014, Livermore CA 94551, Phone (510) 422-5400, Fax 510 424 4320, Email kulander@llnl.gov

PR Centennial Volume Now Available

***The Physical Review: The First Hundred Years*, a special volume edited by Henry Stroke and intended to mark the centenary of that journal, is available to APS members at a special discounted price (see *APS News*, April 1995). Published in conjunction with the American Institute of Physics, the paper version of the volume contains 200 seminal articles published in the *Physical Review* and *Physical Review Letters*, dating back to 1893, that have had a significant impact on the understanding of physics and technology. An additional 1,000 articles are recorded on a CD-ROM that is included with the volume. APS members can order *The Physical Review: The First Hundred Years* by calling 1-800-809-2247, for a 20% discount price of $60.00 (regular list price is $75.00). For more detailed information, contact the AIP Press Sales Department at (516) 576-2483 or www.aip.org/aippress/recent/titles/physical_review.html.**

APS Mass Media Fellowship Program - Summer 1997

Deadline: 15 January 1997

▶ NEW IN 1997!

In affiliation with the popular AAAS program, APS will sponsor two ten-week fellowships for physics students to work full-time over the summer as reporters, researchers, and production assistants in mass media organizations nationwide.

▶ PURPOSE

The intent of the program is to improve public understanding and appreciation of science and technology and to sharpen the ability of the fellows to communicate complex technical issues to non-specialists.

▶ ELIGIBILITY

Priority will be given to graduate students in physics,or a closely related field, although applications also will be considered from outstanding undergraduate and postdoctoral researchers. Applicants should possess outstanding written and oral communication skills and a strong interest in learning about the media.

▶ STIPEND

Remuneration is $4,000, plus a travel allowance of approximately $1,000.

▶ TERM

Following an intensive three-day orientation in early June at the AAAS in Washington, winning candidates will work full-time through mid-August.

▶ SELECTION PROCESS

During February, a review committee will screen completed applications received by the January 15 deadline. Files of the four or five most qualified applicants will be submitted to host media organizations for final selection in April.

▶ TO APPLY

The following materials must be received at the address below by **JANUARY 15**:

- Completed application form (available from the program office, below)
- A copy of your résumé
- Brief sample(s) of your writing (3-5 pages on any subject, written in language understandable to the general public — no technical papers, please), on single-sided, 8 1/2" x 11" paper, unstapled
- Three letters of recommendation (to be mailed directly to the program). Two of these letters should be from faculty members; one should be a personal reference.
- Transcripts of your undergraduate and graduate work (to be mailed directly to the program)

▶ MAIL TO

APS Mass Media Fellowship Program
529 14th Street, NW
Suite 1050
Washington DC 20045

CAUGHT IN THE WEB

Notable additions to the APS Web Server. The APS Web Server can be found at http://www.aps.org

New/Updated Links:

APS News Online (latest edition)

Units
- July 96 DAMOP Newsletter
- August 96 DCMP Newsletter
- August 96 DMP Newsletter

Meetings
- DPP Meeting Program

Education and Outreach
- 1996-97 Travel Grants For Minority Speakers & Women Speakers Program

Journals
- *Physical Review D online*

Membership Assistance Fund

The American Physical Society announces the availability of a membership assistance fund for recently retired physicists or new immigrants to the United States. According to Judy Franz, Executive Officer of the APS, the fund was made possible by a private donation specifically for needy retired physicists or transplanted physicists "…who have no access to physics at present, but have contributed over the years and still have a love of the subject." [Note that APS members of at least 10 years who retire may already choose a reduced dues rate on their annual renewal invoice.] Assistance for APS dues and meeting registration fees will be given on a case-by-case basis as long as the fund exists.

Nominations for qualified individuals or contributions to the fund should be sent to: Barrett H. Ripin, Associate Executive Officer, The American Physical Society, One Physics Ellipse, College Park, MD 20740-3844.

THE BACK PAGE

The Current Energy Situation: Federal Role Remains Important

by the POPA Energy and Environment Committee

Energy problems are now being largely ignored, despite their continuing importance. The near-disappearance of energy from the U.S. public agenda is apparent in the scant attention given to energy topics by the media and by public figures. Some suggestions for governmental action were stimulated by the rise in gasoline prices in the spring of 1996, but the matter was treated as a short-term anomaly — not as a harbinger of more severe difficulties to come. This lack of long term concern is perhaps natural, because fuel supplies are generally ample and prices are still relatively low, with the real cost of gasoline in 1994 only one half the cost in 1981. However, I believe, along with my colleagues on the APS Panel on Public Affairs, that neglect of potential future difficulties is highly imprudent, based on the considerations summarized below.

Consumption Trends

Without adequate energy supplies our society cannot function. The transportation sector is particularly vulnerable to energy disruptions and uncertainties. The coupling between energy and the economy has been reduced, but it is still a reality. Because of the increased efficiency of energy use and because of modal shifts in our economy, the ratio of U.S. energy use to GDP (in constant dollars) decreased by 32 percent from 1973 to 1995, but the rate of improvement in this ratio has fallen sharply since 1986.

In the first period since the oil embargo (1973-86), the GDP rose by 41 percent, while energy consumption rose by less than 0.1 percent. However, in the next period (1986-1995), the GDP rose by 23 percent while energy consumption rose by 17 percent.

On the other hand, energy use on a per capita basis has been relatively constant, dropping by about 14 percent in the decade following the oil embargo, but by 1995 rising most of the way back toward the 1973 value. Since 1975, electricity use has increased almost in lock-step with GDP, rising 72 percent from 1975 to 1995, while the GDP rose 74 percent.

The rest of the world has justifiable aspirations that will entail greater energy use. Energy consumption is growing much more rapidly in the still developing countries than in the industrialized countries of the Organization for Economic Cooperation and Development (OECD). For example, during 1970-1990 energy consumption increased 178 percent for non-OECD Asia (5.3 percent per year), compared to 36 percent for the OECD (1.6 percent per year). Within several decades, these and other developing countries are likely to outstrip the OECD countries in total energy consumption.

The Production of Energy

Let's compare the U.S. consumption of different energy sources for 1973 and 1994 Fossil fuels continue to be the mainstay of our energy economy, providing 85 percent of energy used in the U.S. in 1994. Annual consumption of oil, natural gas and hydroelectric power changed little from 1973 to 1994, while coal and nuclear power each grew by about 6 quads/year and renewable energy by about 1 quad/year.

Natural gas and coal are considered by some to be the "bridging fuels" of the future. U.S. proven natural gas reserves dropped from 200 trillion cubic feet (TCF) to 164 TCF from 1983 to 1994. (1 TCF is about one quad.) The present rate of consumption is 21 TCF/y. Resources may be as high as 1000 TCF, but it is not clear how much of this can be converted to proven reserves. There are very large resources of coal, but their mining and use entails major environmental problems.

Fossil Fuels

U.S. domestic petroleum supplies are limited. U.S. proven reserves of crude oil have declined for seven consecutive years. Low oil prices and a lack of good petroleum prospects are major factors in the downturn in domestic drilling and the success rates. U.S. proven oil reserves dropped from 32 billion barrels (Bb) to 22.5 Bb between 1977 and 1994. According to USGS estimates, the amount of remaining recoverable oil, both discovered and anticipated, is considerably less than the amount of oil already produced. In spite of new Alaskan production, U.S. oil production dropped from 9.6 million barrels per day (Mb/d) in 1970 to 6.5 Mb/d in 1995. The number of discoveries of large fields in the U.S. has greatly decreased and it seems unlikely that many new large fields of oil and gas will be found in the U.S. Since 1980 no discovered field has more resources than the top 100 previously discovered oil or gas fields.

U.S. reliance on oil imports creates problems for the country. The U.S. trade deficit on net petroleum imports was $48 billion in 1995 — about 30 percent of the total trade deficit and 7 percent of total imports. U.S. net petroleum imports have risen 31 percent since the oil embargo (6.0 Mb/d in 1973 to 7.9 Mb/d in 1995). The fraction of U.S. oil from imports was about 50 percent in 1995, and is projected to rise to about 60 percent in 2010. The OPEC fraction of the world oil market is projected to rise from 40 percent in 1990 to 52 percent in 2010, as a result of the fact that OPEC countries have a large fraction of remaining oil resources. The Middle East continues to be a region of potential political instability. The U.S. fought the 1991 Persian Gulf War in part to defend the unimpeded flow of oil to OECD nations. Dependence on Persian Gulf oil has motivated U.S. arms shipments to that region and increased military involvement. Europe and Japan have partially prepared themselves for future petroleum shortages by using considerably higher gasoline prices ($4/gallon) to raise revenue and moderate demand.

Environmental Impacts

Production and combustion of fossil fuels are harmful to the environment. Forty urban areas violate at least one of the U.S. ambient air quality standards, adversely affecting human health. Many foreign cities have considerably worse air quality problems. Automobiles contribute about one-half of the cities' air pollution.

If current trends in fossil fuel use continue, carbon dioxide concentrations will double in the next century. According to the Intergovernmental Panel on Climate Change, changes in weather and temperature patterns, particularly the spatial pattern of temperature changes, all point to "a discernible human influence on global climate." The aggregate impacts of changes in temperature, precipitation, and sea-level, while uncertain, are likely to be harmful to both human and natural systems.

Energy Efficiency Gains

Buildings and appliances consume about 40 percent of U.S. energy; there are great opportunities to reduce these energy requirements. New building diagnostic computer codes allow architects opportunities to use new energy-management techniques. The need for space heating in new large buildings and houses can be decreased by more than 50 percent on a cost-effective basis. Because of the long lifetime of buildings and the incomplete application of energy standards for buildings, the national transition to more energy efficient buildings will be slow. However, an Energy Information Administration (EIA) study found that houses built after 1988 consume only 59 percent as much natural gas as those built before 1980. From 1972 to 1990, new refrigerator energy usage dropped from 2000 kwh/year to about 800 kwh/year.

Transportation alternatives are an extremely important challenge. Because transportation uses 2/3 of U.S. petroleum and over 1/4 of U.S. energy, it is a very critical target for energy savings. Since the oil embargo of 1973-74, the number of registered passenger cars has risen from 102 million to 147 million, an increase of 44 percent. The DOE's EIA projects that vehicle miles traveled by light duty vehicles will increase by 1/3 by 2015. The U.S. is saving huge amounts of fuel and billions of dollars a year because the current standard (average) fuel economy for new automobiles of 27.5 miles/gallon is twice the 1973 fleet average of 13.5 miles/gallon.

Alternatives to Fossil Fuels

Alternatives to fossil fuels are nuclear fission and fusion; solar sources such as photovoltaics, biofuels, wind, hydro, and solar thermal; tidal; and geothermal. These energy sources are sufficient to sustain the Earth's economy, but in most cases the costs are not now competitive with fossil fuels. Renewable energy sources are not widely replacing fossil energy sources.

Nuclear fission's role will diminish without new initiatives. In 1995 nuclear energy's share of the electricity generated by utilities was 22 percent in the United States, 76 percent in France and 33 percent in Japan. Nuclear energy has risen from a negligible contributor to U.S. electricity generation in 1970 to the second largest source after coal in 1995, substantially moderating the need for fossil fuel sources. No new reactors have been ordered in the U.S. for more than 20 years. Several versions of improved reactors are expected to be available for pre-licensing shortly, but there are no immediate prospects for U.S. utility purchases. No decisions have been reached in the U.S. on the location of either interim or permanent nuclear waste repositories, and it is not clear that a coherent, politically acceptable, nuclear waste disposal program can be established in the near future.

David Hafemeister,Chair POPA

The Federal Role

Science and technology have had major successes. Energy R&D has produced new and improved products and accelerated market penetration, such as combined-cycle power plants, compact fluorescent bulbs, enhanced nuclear safety, more efficient automobiles, high bypass ratio jet engines for airplanes, improved building designs, catalytic converter mufflers, improved photovoltaic cells, more reliable wind mills, and so forth. R&D is necessary to enhance development of future energy sources and to improve end-use energy efficiency.

The federal government has an essential role in addressing problems with long time horizons, particularly when they involve potential threats to the national security and well-being. Industry will typically invest in products that have a relatively short payback period. However, energy problems may require several decades of development and success is not assured. Federal help is needed to fill the gap. This should be done with a stability in funding that goes beyond the yearly Congressional budget cycles.

This article is based on a document prepared by the Energy and Environment Committee of the APS Panel on Public Affairs (POPA), an effort led by Chair David Hafemeister (California Polytechnic State Univ.). D. Bodansky, Univ. Washington; A. Brecher, Dept. Transportation; P. Craig, Univ. California-Davis; A. Fainberg; B. Hammer, Amer. Inst. Physics; R. Howes, Ball State Univ.; S. Smith, AAAS-EPA Fellow; R. Socolow, Princeton Univ. and E. Stechel, Sandia Nat. Lab. also contributed to its preparation. See the POPA homepage (http://aps.org/public_affairs/popa/studies.html) for the full version of this paper.

The Back Page is intended as a forum to foster discussion on topics of interest to the scientific community. Opinions expressed are not necessarily those of the APS, its elected officers, or staff. APS NEWS welcomes and encourages letters and submissions from its members responding to these and other issues.