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NEWSLETTER

Lawrence Berkeley Laboratory
Applied Science Division

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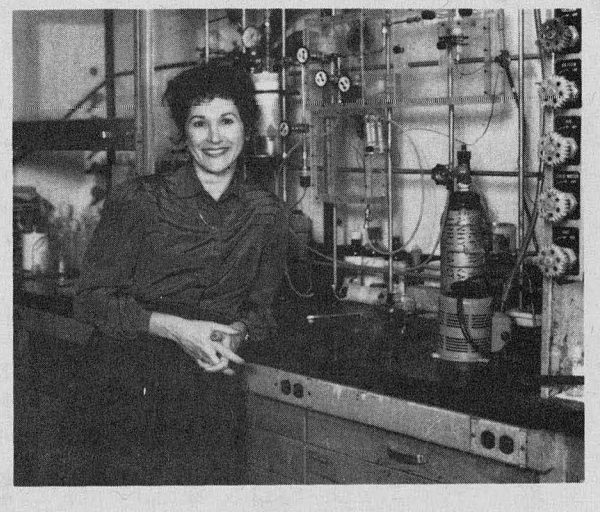
INTERVIEW WITH PAT HULL



Pat Hull is a Staff Scientist who works with Arlon Hunt on solar thermal conversion technology. She is on extended leave from Tennessee State College and has been at LBL since January 1984. The following is from a brief discussion with Pat:

ASD: I know that it was considered unusual for a woman to study science when you graduated from college. Would you describe your educational background?

Pat: I graduated from Auburn University in Alabama in 1960, and I was the first woman to graduate in physics from that school. After I left Auburn, I went to work for Lockheed Aircraft in Marietta, Georgia, as a flight test engineer, testing an early vertical-takeoff plane. In 1964, I decided to go back to graduate school for a Ph.D. in Physics. I wanted to attend Georgia Tech in Atlanta, but they did not admit women in the non-engineering program at that time. I contacted an attorney from the ACLU, but we did not have to take the case to court because the President of Georgia Tech petitioned the Board of Regents to admit me as an exception. He further requested that they change the policy to open the program to any qualified woman, which they subsequently did. My graduate education was a little difficult because during this period I had two young sons also competing for my attention. However, in 1970 I became the first woman to receive a Ph.D., in any area, from Georgia Tech.

ASD: What circumstances brought you to Nashville, Tennessee after you completed your Ph.D. in Physics?

Pat: I accepted a teaching position at Tennessee State University in Nashville because my husband wanted to go to graduate school at Vanderbilt. At Tennessee State the Physics and Math departments were combined and there was no graduate program in physics. There was really no opportunity for research in high energy physics, my area of concentration in graduate school.

ASD: How did you become interested in solar research?

Pat: Although I was enjoying teaching at Tennessee State, the absence of research opportunities there made me begin to look around for other possibilities. I spent the summer of 1975 at Lawrence Livermore Laboratory at a special Faculty Institute. I worked on a project in solar energy, calculating the heat-loss coefficients for shallow solar ponds, and that was my first experience with solar energy. This work was far removed from high energy physics, but a lot of my mechanical engineering background was applicable. I really enjoyed it, though it was very different from the kind of research I had expected to do when I went to graduate school.

I spent the summer of 1978 at LBL, also at a Faculty Institute, and I ended up working with Arlon Hunt in solar energy. This was a very new experience with a use of solar energy that I hadn't even imagined: using small particles to absorb the sunlight. In 1979, Frank Asaro, knowing how much I wanted to come back to LBL, helped me get a summer faculty grant through Northwestern University. That was a wonderful opportunity because I was able to come back to work with Arlon. In subsequent summers, Arlon was able to bring me back to work at LBL with his own funds, as by then his program had been funded by DOE. I have been on extended leave from Tennessee State since January 1984, and my leave is scheduled to end in August of this year.

ASD: Would you describe the work you are doing here on the solar thermal conversion project?

Pat: We are studying the use of concentrated sunlight to produce chemical reactions in small-particle suspensions. We want to use small particles because we think they are ideal absorbers for sunlight as they have a very large surface area for the amount of mass. By "small" I mean submicroscopic particles, less than one micron in diameter. We first need to develop some sort of technology base to understand how particle suspensions absorb sunlight. We have built a solar simulator, which is basically an ellipsoidal reflector, for experiments in which we actually suspend the particles, pass them through a reactor, and observe the heating effects.

Besides doing analytical and experimental programs for understanding how small particles absorb sunlight, we want to look at chemical processes that offer the potential for using these particles in some unique way. It would be great if we could find some chemical reactions that can only be done by solar energy by taking advantage of the unique properties of concentrated sunlight. The very high flux density gives an increased probability of photo-chemical effects, and by using small particles, we have the possibility of getting very high temperatures for chemical reactions without a high temperature heat exchanger or unnecessarily heating the reaction vessel walls.

ASD: What directions do you see this research taking in the future?

Pat: Not a lot of research is being done in this area, so I think we have a big task ahead of us. We are building a sound analytical basis. We have the optical absorption coefficients and the fraction of energy absorbed by the particles for a lot of different materials that would be potential absorbers. We now have a model that presents a good way to determine the temperature of the particle and the gas, and the difference between the particle and gas temperatures under different conditions of radiant flux and different particle loadings. We need better ways to measure temperatures of particles and gases; we need a way to determine the temperatures of the particles and gases at the same time when they are not the same temperature.

We also need to find new and better methods to detect various chemicals. Gas chromatography is a standard technique, but it has limited applications. We are looking at x-ray diffraction patterns in particles, before and after chemical reactions, to see if their crystalline structures have changed. There are a lot of things you can do with particles in chemical reactions. We started off by just using the particles to heat the gas. With hot gas you can run a turbine or heat engine to produce electricity, or you can take another approach and use the hot gas for some chemical process. A particle can be a catalyst or the feed stock of a chemical reaction. You can actually process the particle itself, make some change in it by letting it absorb the light, and change its chemical structure.

ASD: What directions do you see Pat Hull taking in the future? Does she go back to Nashville and teach physics, teach physics in Nashville <u>and</u> spend her summers at LBL, or work full-time on research at LBL?

Pat: The direction I will be taking depends a lot on my new husband. I was remarried last June to an attorney from Nashville, Tennessee. He really likes the Bay Area, but is not licensed to practice here. If my career opportunities really open up here, he has agreed to take the California Bar exam in July. I guess it is just a question of wait and see.

UPDATE ON SNAP

The fourth cycle of SNAP (Search for New Areas & Projects) has been completed. The members of the SNAP Group for this cycle were Paul Berdahl (Chair), John Girman, Kim Kinoshita, Don Lucas, Ron Ritschard, and Don Grether (ex-officio). Altogether, the Group evaluated nine proposals and considered all of them as of high quality and presenting interesting ideas. The Group was able to narrow its attention to what it regarded as the top three, and (as a new feature of the review process) invited a representative of each to give a brief presentation and answer questions. Although this step was considered quite useful and informative, the Group was not able to arrive at a consensus as to a ranking of the proposals. The reasons were twofold: 1) each of the three proposals is strong but quite different from the others, and 2) each member of the SNAP Group brings a different perspective to the review process. After much deliberation, the Group recommended to Elton all three proposals.

Although the recommended number of proposals was somewhat outside the SNAP guidelines, Elton and the Division Council decided to pursue all three. In no particular order, they are:

Environmental Modification on a Metropolitan Scale (Heat Islands in the Summer), Hashem Akbari, Joe Huang, Ron Kammerud, Ron Ritschard, and Art Rosenfeld. Most energy conservation research focuses on individual buildings and components. This project will address the savings in energy and electric capacity that could result from conservation measures which impact urban areas as a whole. For example, planting of vegetation should reduce the urban heat island effect and reduce the demand for electric air conditioning. Another technique is to reduce the area's solar albedo by making buildings and streets lighter in color. Although many of the techniques are known and have been practiced to some extent, quantitative and generally applicable analyses of the benefits and costs are not presently available.

Nitrous Oxide Formation in Combustion, Nancy Brown. Much attention has been given lately to the "greenhouse" effect of CO_2, which is predicted to raise the average temperature of the earth and otherwise cause climate change. Nitrous Oxide, N_2O, is a potentially important "minor" greenhouse gas that also has the potential of causing reductions in stratospheric ozone levels. However, little is known about its formation during combustion and whether it may prove to be inexpensive to prevent that formation. Brown's project would start by undertaking preliminary combustion experiments in a flat flame and a turbulent flow reactor, using electron capture gas chromatography to measure the N_2O.

Enhancement of Photosynthetic Productivity by Application of New Flashlamp Technology, Les Packer and Sam Berman. This work is a multidisciplinary effort that combines research on photobiology (Packer and coworkers) with research on advanced lamp technology (Berman and coworkers). It is known that certain plants maintain or even increase their productivity under rapidly cyclic light conditions, opening the possibility of saving energy in environments where plants are grown under artificial light. Two examples are greenhouses at high latitudes (e.g.,

Alaska), and space stations or space vehicles on long voyages. The project will investigate the wavelengths and light/dark cycles which optimize photosynthesis in the blue-green algae Spirulina, and develop new fluorescent lamps to provide this illumination.

VISITING RESEARCHER

Since July of 1984, Olivier de la Moriniere has been a visiting researcher working with the Buildings Energy Data group of the Energy Efficient Buildings program. He is a group leader with the Agence Francaise pour la Maitrise de l'Energie (AFME), a government agency similar to the U.S. Department of Energy. In France he is involved with funding research programs dealing with building energy control. He plans to be at LBL until June 1986, and his wife and three-month-old son live with him here in Berkeley.

A native of Rennes in the Brittany region of France, de la Moriniere attended the Ecole Polytechnique in Paris, where he received a degree in 1979, and the Ecole des Ponts et Chaussees, which granted him a doctorate in Civil Engineering in 1981. After taking his advanced degree, he was employed by Habitation à loyer modere (HLM), a French firm engaged in construction of government subsidized, multi-family dwellings for low income tenants. At HLM, Olivier wrote computer programs that could predict energy savings from the installation of various kinds of retrofits.

For the Buildings Energy Data group, Olivier has been working to develop a data base on cool storage technologies in new buildings, which will be used to analyze the cost effectiveness of generating and storing ice and/or liquid coolants when power demands are lowest. Such an economic evaluation can be difficult because of the complex interrelationship of costs and benefits from new technologies, but the systems under analysis are promising because of their relatively short payback times. Olivier hopes to apply some of the knowledge he gains here to the analogous problem of thermal-storage technologies in France, where heating rather than cooling is the more significant air comfort problem.

ATMOSPHERIC AND BIOSPHERIC EFFECTS OF COMBUSTION

In order to further the Division's new Initiative on the Atmospheric and Biospheric Effects of Combustion, a Center has been created and a search started for a Center Director. The Director will be responsible for coordinating the efforts of a number of scientists, including chemists, physicists, engineers, biologists, geologists, meteorologists, and energy analysts, to carry out the objectives of the Center. He/she will also work towards obtaining research support from governmental and non-governmental organizations, and will represent the Laboratory at various related national and international meetings.

A search committee for the Director of the Center, established February 8, includes Nabil Amer, Harold Johnston, Martha Krebs, Tica Novakov, Alex Quintanilha (ex-officio), and Ron Ritschard (Chair). The position is currently being advertised in Science, Nature, Physics Today, Environmental Science and Technology, The Wall Street Journal, and Chemical Engineering News. Another component of this Center will be an Advisory Board. Candidates for such an Advisory Board have been selected and will be contacted in the very near future to find out whether they are willing to serve as members of the Board. Professor William Nierenberg, Director of Scripps Institution of Oceanography, has already accepted.

A major issue is, of course, funding. Possible sources of funding are being investigated not only within the Department of Energy, but also at the Environmental Protection Agency, the Department of Defense, and other funding institutions. Guidance in this effort is being sought from the National Acid Precipitation Assessment Program and its Director, Dr. Christopher Bernabo.

WHAT WORKS - Documenting Energy Conservation in Buildings

WHAT WORKS - Documenting Energy Conservation in Buildings is a publication which distills the research and experience of more than 200 foremost energy researchers, architects, engineers, and managers, from utilities, universities, private industry, and government. This book presents a summary of current research and experience presented at the Second Summer Study on Energy Efficiency in Buildings and contains 35 selected papers that explore each subject in depth. Jeff Harris, from the Buildings Energy Data group is the editor, with Carl Blumstein as co-editor. The book is being distributed by the Energy Conservation Coalition for the American Council for an Energy Efficient Economy. For more information, you may contact the Buildings Energy Data group or write to ECC, 1001 Connecticut Avenue, N.W., Suite 535, Washington, D.C., 20036.

INVITED TALKS AND FOREIGN TRAVEL

January

- Arlon Hunt delivered a guest lecture at Wheaton College in Boston, Massachusetts. The title of his talk was "Capturing Sunlight with Smoke: New Approaches to Energy Conversion and Conservation Through the Use of Microstructured Materials."

- Art Rosenfeld was an invited speaker at the meeting of the Committee on Electricity of the National Academy of Sciences. He spoke on "Electricity Use in Buildings and New Technologies for Building Load Management."

- A large contingent of ASD personnel attended the American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) conference in Chicago. Among them, Brian Pedersen, Alan Meier, Gregory Traynor, and William Fisk presented papers: Pedersen on "Formaldehyde and Tracer Gas Transfer Between Airstreams in Enthalpy-Type Air-to-Air Exchangers"; Meier on "Measured Electricity Use of Drinking Fountains and Water Coolers"; Traynor on "Pollutant Emissions from Unvented Combustion Space Heaters"; and Fisk on "Performance of Residential Air-to-Air Heat Exchangers During Operation with Freezing and Periodic Defrosts."

- Alan Meier traveled to the Oak Ridge National Lab in Tennessee to present the latest results from Building Energy Compilation and Analysis (BECA) data bases and to demonstrate their on-line capabilities.

- Nabil Amer gave a talk at the Los Alamos National Laboratory in Santa Fe, New Mexico. The talk was titled "Spatially-Resolved Investigation of Thermal and Optical Properties of Thin Films: A Photothermal Approach."

February

- Richard Szydlowski presented a paper at the University of Arizona in Tuscon. The subject of the paper was "The Energy Signature Monitor (ESM), A Low-Cost Class B Data Acquisition System."

- Terry Parker, Chris Edwards, and A.K. Oppenheim attended a conference of the Society of Automotive Engineers in Detroit, where Parker and Edwards delivered papers co-authored by Oppenheim. Parker spoke on "The Induction Period for Ignition of Fuel Sprays at High Temperature and Pressure," and Edwards on "A Photographic Study of Plasma Ignition Systems."

- Joseph Klems was invited to present a paper at the Workshop on Laboratory Measurements of the U-Values of Windows conducted by the National Bureau of Standards, Gaithersburg, Virginia. The paper

was titled "Toward Accurate Prediction of Comparative Fenestration Performance."

- Nancy Brown traveled to Cairo, Egypt to attend a symposium on energy research, sponsored by the Foreign Relations Coordination Unit of the Supreme Council of Egyptian Universities. There, she delivered an invited paper titled "Chemistry and Detection of Combustion-Generated Air Pollutants."

- Arlon Hunt gave a talk on "Solar Radiant Processing of Gas-Particle Systems for Producing Useful Fuels and Chemicals" at a SERI (Solar Energy Research Institute) workshop in Lakewood, Colorado.

- Alan Meier conducted a seminar on "Supply Curves of Conserved Electricity" before a policy evaluation group at DOE Headquarters in Washington, D.C.

- David Grimsrud presented a paper at the Center for Building Technology Federal Workshop on Indoor Air Quality, sponsored by the National Bureau of Standards. The subject of the paper was "Radon Entry into Dwellings."

- Param Tewari delivered a paper on the "Structure and Chemistry of Sol-Gel Derived Transparent Silica Aerogel" at the International Conference on Ultrastructure Processing of Ceramics, Glasses, and Composites. The conference was held at the University of Florida in Palm Coast, Florida.

SHORT COURSE: ENERGY SOURCES: CONSERVATION AND RENEWABLES

The above course is being sponsored by the Forum of the American Physical Society (APS) and the American Association of Physics Teachers. It will be held in Washington, D.C. on April 27-28, 1985, after the APS meeting. The faculty for this course are nationally-renowned "experts" in their fields of study. They will discuss the progress and possible future directions in conservation (enhanced end-use efficiency) and in renewable resources. The workshop is intended for a physics-based audience, and is being organized by David Hafemeister (Cal Poly U), Henry Kelly (Office of Technology Assessment), and Barbara Levi (Princeton). The following ASD scientists are among the faculty for the course: Art Rosenfeld, "Energy Efficiency in Buildings: Progress Since 1973 and Future Potential"; Art Rosenfeld/Bruce Birdsall, "Heating, Ventilation, and Thermal Flows and Storage in Large Buildings"; Tony Nero/David Grimsrud/Rich Sextro, "Indoor Air Pollution: Dependence on Sources, Ventilation Rates, and Other Factors"; Steve Selkowitz, "Window Technologies"; Sam Berman, "Lighting Technologies". For more information, contact David Hafemeister, 553 Serrano, San Luis Obispo, CA 93401; (805) 544-5096.

NEW APPOINTMENT TO PROFESSIONAL STAFF COMMITTEE

Elton recently appointed Nancy Brown to the Division's Professional Staff Committee, and would like to thank Frank Robben for his valuable contributions to the Division through his membership on this committee. The Professional Staff Committee, together with the Division Head, establishes Division policy with respect to the employment and advancement of the scientific staff. The Committee also makes recommendations on Staff Scientist indefinite appointments, Senior Staff appointments, and promotions within the Staff Scientist series. The present membership of the Committee is:

Michael Wahlig, Chairperson
Arthur Rosenfeld
John Harte
Michael Rothkopf
Lester Packer
Nancy Brown
Elton Cairns (non-voting)
Jan Smith (staff)

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Lawrence Berkeley Laboratory, University of California
Berkeley, California 94720
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