# HOTLINE

PRINCETON PLASMA PHYSICS LABORATORY

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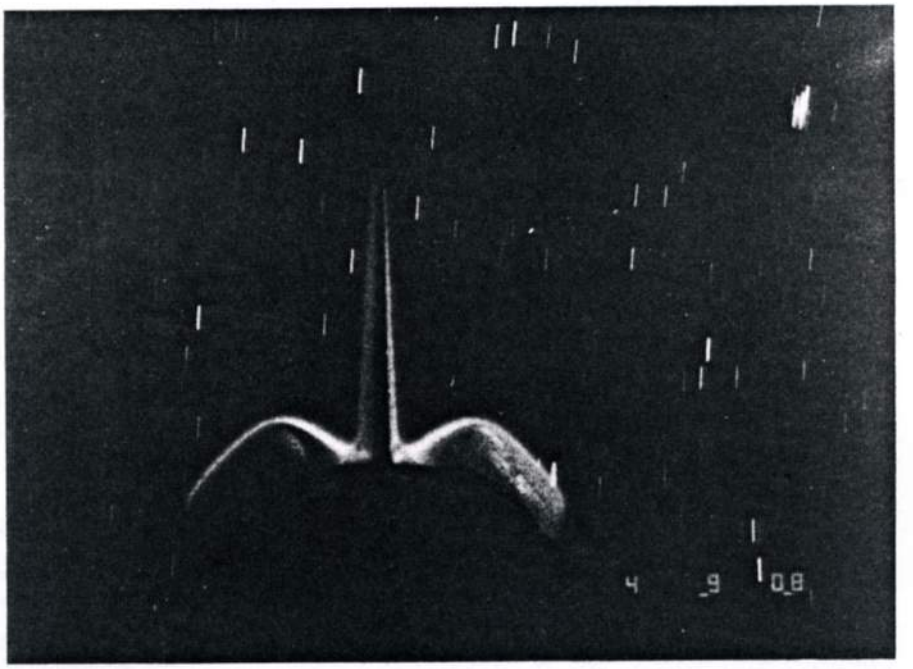
# SHUTTLE GLOW EXPERIMENT



*The glow visible on the surface of the tail fin and engine pods of the orbiting space shuttle is under investigation by a group of PPL physicists. (Photo courtesy of NASA)*

A group of PPL scientists bring outer space into the laboratory daily through their investigation of the phenomenon of spacecraft glow. Discovering why the glow appears may shed new light on which materials are best suited for fabrication of space-bound astronomical telescopes and vehicles.

Spacecraft glow is a luminescence that occurs only on the side of the craft facing the direction of travel while in orbit. It has been observed in the past on other orbiting spacecraft, such as the Atmospheric Explorer Satellite, and was most recently observed and photographed during space shuttle flights.

The goal of the spacecraft glow experiment is to understand what causes the luminescence. One theory contends that the glow may re-

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## Survey Schedule

The Employee Attitude Survey is scheduled for Thursday, June 12, and Tuesday, June 17. Opinion Research Corporation (ORC) will conduct four survey sessions on each of the two days to make participation convenient for all PPL employees.

Schedules established for each division will provide at least two sessions for employee participation. Supervisors will be asked to divide their staffs between sessions to avoid overcrowding and for privacy during the survey.

According to ORC, a high employee participation rate in the survey is important to most accurately assess staff attitudes and concerns. In a memo to all PPL employees, Dr. Harold Furth has encouraged members of all laboratory staffs to take part in the survey.

Most people will complete the survey in 30 to 45 minutes. An ORC staff member will conduct each session and will collect and secure all completed survey forms. No information will be released by ORC that will permit identification of any PPL employee.

sult from the excitation of atoms and molecules contained in the earth's thin outer atmosphere (which has a density of $10^9$ to $10^{10}$ $cm^{-3}$) as they strike the spacecraft's skin. Since the shuttle travels at approximately 8 km/sec, the energy transferred to these particles through collision is 5 to 10 electron volts (eV). That energy may be sufficient to excite atmospheric nitrogen or oxygen, causing them to emit photons and creating the glow.

An alternate theory suggests that the glow stems from chemical reactions between atmospheric particles and the spacecraft's surface. The chemical changes as particles hit and react with the surface, forming new molecules and creating chemiluminescence.

While the glow is harmless to the spacecraft, the light it generates poses problems for astronomical observations made from space. The glow causes a fog-like effect in observations made by orbiting space telescopes, reducing their effectiveness for very sensitive measurements.

In addition to the glow, the impact of oxygen causes erosion of spacecraft surfaces. Understanding the mechanics of material erosion in space would be useful in designing future spacecraft or orbiting space stations. Selection of construction or insulating materials prone to significant erosion during prolonged periods orbiting in space could then be avoided.

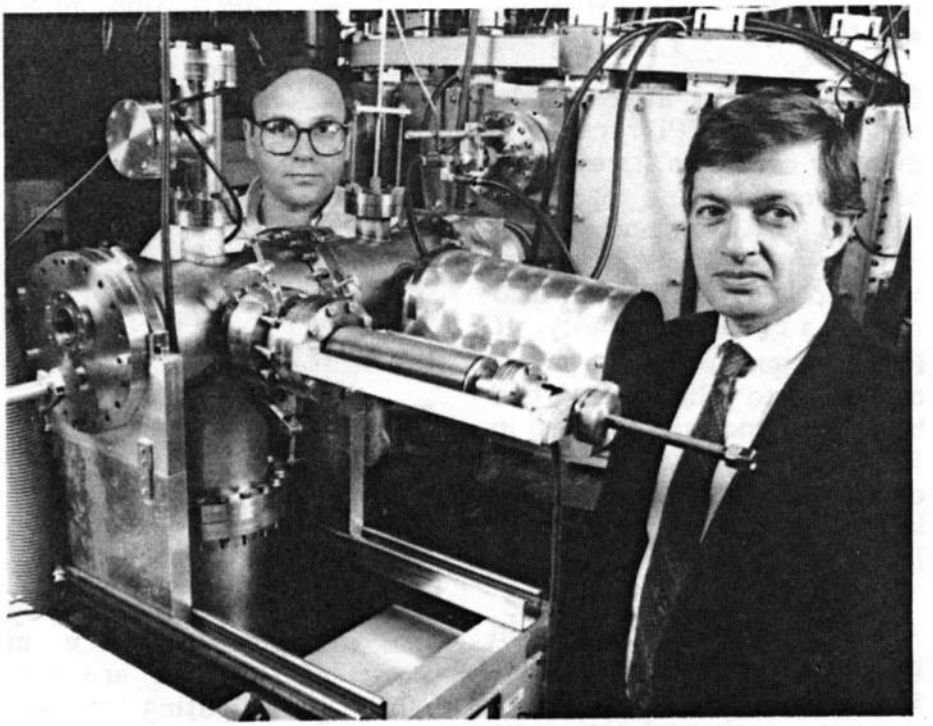
In space, experiments designed to analyze the glow are detailed and costly. Therefore, several groups are attempting to simulate orbital conditions in the laboratory to investigate the phenomena further.

To reproduce the environment orbiting spacecraft encounter, a beam of neutral particles that will strike a surface at 8 km/sec must be created. Investigators estimate that the glow effect requires particles with energies of between 5 and 10 eV and a flux of approximately $10^{14}$ atoms/$cm^2$/sec striking an orbiting spacecraft's surface. Several research groups are attempting to produce the neutral particles through traditional methods, such as charge exchange or photodetachment of ions. However, these methods are inefficient for producing large quantities of low energy neutrals. "They're taking old technologies and pushing them to their limit," said Bill Langer, PPL's principal investigator on the spacecraft glow experiment. "We developed a novel technique to produce an intense source of neutrals."

Langer became aware of the research into spacecraft glow in the summer of 1984. By January 1985, he and several colleagues were actively pursuing funding for their new approach to the problem. He credits PPL Deputy Director for Technology J.R. Thompson for being "instrumental in getting NASA to look at our approach to this problem." Through NASA's Space Telescope project, approximately $200,000 of "seed money" was given to PPL for its development of a beam and initial examination of the glow phenomenon. By April 1985, the first funding arrived.

Although the project is separate from PPL's fusion work, Langer regards it as an outgrowth of the laboratory's program. He maintains that this approach to the problem would have been unworkable without either PPL's facilities or the expertise in plasma surface interactions and impurity studies available here.

The PPL proposal involves creating a plasma and allowing some of it to strike a wedge-shaped limiter. The experiment makes use of the Current-Drive Experiment (CDX), which was formerly the ACT-I machine. As ions drift outward from the central plasma, they hit the limiter, which is energized at a



*Dennis Manos (left) and Bill Langer (right) stand beside the spacecraft glow experiment. The apparatus is installed in a port on the Current-Drive Experiment (CDX).*

specific bias voltage. The plasma particles are neutralized on impact and richochet off the limiter into a drift tube to create a low-energy neutral beam. Solid or gas targets are inserted into the opposite end of the drift tube, and any resulting luminescence is measured with filters and phototubes. The filters will eventually be replaced by spectrometers.

The PPL team working on the spacecraft glow experiment includes Langer, Sam Cohen, Dennis Manos, Bob Motley, Masayuki Ono, Steve Paul, and graduate student Don Roberts. The group completed initial experiments in October of last year after having produced neutral beams of the correct flux and with controllable energies. "Proving we could make the beam was the hard part," Langer said.

In the initial experiments, neutral beams of nitrogen were used to bombard solid and gas targets. With solid targets such as Chemglaze (an optical paint used on spacecraft), a glow too faint to be observed with the naked eye was produced. The glow was most intense on the surface of the solids, growing fainter farther out from the surface. Both of these observations provided ground-based replication of effects similar to those observed in space. There are suggestions that some part of the shuttle glow is caused by beam collisions with gases in front of the vehicle surface. To test these theories, chemiluminescense experiments were conducted with carbon and nitrogen oxide gas targets, each gas was found to emit a different glow under test conditions. Langer said, "While the glow observed in our tests may be produced by a mechanism similar to that responsible for spacecraft glow, the relevant experiments require using oxygen beams. Work on these beams is underway right now."

While most erosion studies are conducted using energies much lower than 1 eV, there remains a whole regime of unexplored erosion and chemiluminescent reactions occurring with 1 to 10 eV beams. PPL investigators are continuing to explore this area with the capability provided by CDX. Preliminary experiments have shown that various gases cause different erosion rates: while nitrogen caused very little erosion of a carbon target in three hours, for example, oxygen almost completely eroded the target in less than two hours.

Langer said, "In our initial experiments, we've demonstrated our ability to develop a good low-energy neutral beam source, and use it to produce chemiluminescence on solid and gas targets.

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We're now conducting more detailed experiments, varying the properties of the beam and targets, and taking higher resolution spectra to identify the molecules producing the chemiluminescence. In this way, we hope to understand the physical and chemical mechanisms causing the glow and erosion. In addition, our results will help in the design of spaceborne telescopes, satellites, and perhaps the future space station."

## Interruptible Load

PPL's participation in the Public Service Electric and Gas (PSE&G) Company's interruptible service program will save the laboratory over a million dollars in utility charges.

PPL is among 33 PSE&G customers who contracted for interruptible electric service this year. The contract stipulates that if PPL receives an interruptible load request from the utility, the laboratory will reduce its electrical requirements to a contractually agreed-upon level in half an hour. Power interruptions may occur at any time during the year; however, they are most likely during summer periods of hot, humid weather with heavy air conditioning loads. Power reductions are expected to last a number of hours, probably for the balance of any work day in which they are ordered.

The contract is mutually beneficial, providing PSE&G with the ability to handle heavy power demands without expending capital to construct additional power plants.

By choosing the interruptible service option, PPL receives a monthly credit on its electric bill, amounting to a total savings of just over one million dollars annually. However, interruptible service also carries a potential penalty. If PPL is requested to cut power demands to the pre-agreed base level and fails to do so in 30 minutes, very heavy charges are assessed for every kilowatt used above that base level.

At PPL, load reductions will be met primarily through shutdown of all experimental devices. Procedures have been established with all personnel who will be involved in shutting down the necessary devices and supporting equipment.

For information purposes, employees will be notified of any power reduction through the Emergency Voice Evacuation System (EVES) and the TFTR public address system. This announcement is intended to alert staff involved directly in the shutdown. Other employees can assist reduction efforts by turning off non-work-related electrical equipment, such as lighting in unoccupied areas. However, unless specifically directed by lab management, normal office and support work should not be interrupted by shutting down electrical equipment. Other than the scheduled shutdown of experimental devices, work will not be interrupted to reduce the electrical load.

If you have any questions concerning the possible impact an interruption might have on your work, please call Bob Gulay at ext. 3255.

## Personnel Outreach

Since PPL's reduction in force in July of last year, the laboratory has kept a helping hand extended to employees affected by layoffs.

With the assistance offered through the Personnel Division, 95% of those who were laid off in July have succeeded in getting equivalent or better positions with other employers. Those affected by the reduction in force in March of this year are currently participating in laboratory-supported efforts to help them identify new employment opportunities.

Due to funding cutbacks and program redirection, a total of 31 exempt and non-exempt employees were separated from the laboratory in June 1985. Additional funding reductions resulting from the passage of the Gramm-Rudman-Hollings Act necessitated a further involuntary reduction of 29 employees this March.

Along with supplying severance pay and benefit coverage, the laboratory constructed, equipped, and staffed "outplacement centers" to help these employees obtain jobs with other firms. The Personnel Division works closely with Right Associates, a professional outplacement group, to provide assistance in resume preparation, interview training, and other job-search related activities.

Both group workshops and individual counseling sessions

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help separated employees develop their personal reemployment campaign. Although most employees affected last July have found new positions, a followup seminar was conducted in September for individuals who were still unemployed.

PPL Manager of Employment Barry Cohen remains actively involved in providing job search support to individuals directly affected by the reductions in force.

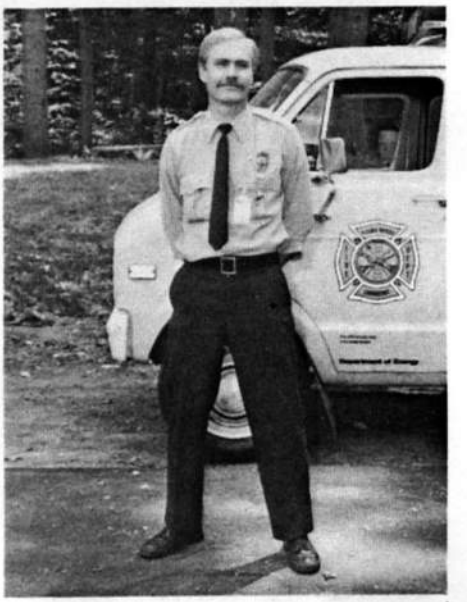
## Security Merger

The merger of the Security Department with the Emergency Services Unit (ESU) has not left the laboratory unprotected. The new organization, the Department of Public Safety, continues to keep the laboratory secure -- at a savings of more than $200,000.

The new department was created when the merger took effect last July. The new name better defines the full scope of the department's responsibilities, which include security, fire suppression, rescue, hazardous materials containment, and emergency medical treatment on the Forrestal Campus.

Much of the restructuring was suggested by Associate Head of Public Safety Jack Anderson, who drew on his experience with the Port Authority police. "Back in 1937," he recalled, "the Port Authority started training their people in police procedures, structural firefighting, and first aid. They're now a very diversified unit -- they have Emergency Medical Technicians (EMTs) and paramedics, as well as personnel trained to respond to crashes, rescue, hostage situations, and all the other facets of emergency service."

*Tom Maple demonstrates the versatility of Emergency Services Officers, security officers who respond to emergencies as either firefighters or emergency medical technicians.*



Anderson pointed out that "I presented a plan for providing similar training for our Security and ESU people several years ago. In the long run, the training is cost-effective; in fact, the escalating costs of police and fire fighting protection was what finally changed people's minds. We were also working with people who have the intelligence and drive to make this merger work. It's a common-sense approach to safeguarding the laboratory, and the dedication of the people involved has made it successful."

The merger resulted in the creation of the Emergency Services Officer (ESO) position. Four Security officers -- Tom Maple, Al Hoagland, Ed Murfit and Wes Foraker -- became Emergency Services Officers. An additional five officers -- Tom Furman, Steve Kidd, Jack Jones, Dick Weisel and George Warshany -- were drawn from the existing ESU program. These 9 ESO's now provide PPL with year-round, round-the-clock coverage for security, emergency services, and fire protection.

The ESO's function as security officers at all times during their shift. If an emergency occurs, however, they respond as either firefighters or emergency medical technicians (EMT's) as needed. To allow the ESO's to "change hats" as neecessary, they receive training in security, first aid, and fire fighting. They hold N.J. State Fire College firefighting certification (or its equivalent), and are taking the state EMT courses. Training is ongoing to ensure compliance with all state and federal standards.

The ESO's are part of a highly skilled team, drawing on the expertise of other PPL volunteers as needed. The laboratory's 30-member volunteer

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ESU force encompasses captains, driver-operators, firefighters, and EMT's. In emergencies involving hazardous materials or requiring rescue, personnel can be drawn from all four categories.

The merger's benefits extend beyond cost reductions, however. As a result of recent training, Forrestal Public Safety Director Al Guyet has seen a marked increase in morale. "When you're in a position that has some risk and requires a lot of teamwork, morale develops very quickly," Guyet explained. "Firefighting is just such an activity, and I've seen that happening with the Emergency Services Officers."

Opportunities and options for career advancement also accompanied the merger. But perhaps most importantly, Guyet thinks the cross-training has resulted in an increase in mutual respect between emergency services officers and security officers. Anderson agrees, adding that the carryover of respect extends throughout the entire department. "Everyone now knows what everyone else has to do in an emergency, and they've learned to respect each other's specialties."

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*Teri Hamilton*

## Print Shop Supervisor Becomes Published Poet

Teri Hamilton now has something in common with Robert Frost and Elizabeth Barrett Browning. For Teri, PPL's Duplicating Center supervisor, has become a published poet.

Her poem, "You and I," has been published in the "American Poetry Anthology." The volume, which is intended for use as a school textbook and as a reference for editors and publishers, was edited by John Frost and published by the American Poetry Association of Santa Cruz, California.

Although "You and I" is Teri's first published work, three more poems are awaiting publication. Her poetry will soon be featured in "Inspirational Writings - Volume 2," the "National Poetry Society's Anthology," and "Hearts on Fire - Volume 3."

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Teri began writing poetry seven years ago. She wanted to speak frankly about herself; not being inclined to verbalize her feelings, she turned to writing as an avenue for "literal sharing."

"All communication is sharing," Teri contends, "All people are related through the similarities of our life experiences, and everyone can relate to something about another person. Human beings grow by sharing, and my creative way of sharing is writing poetry." She regards her poems as mirrors, illuminating feelings her readers can identify in their own lives.

Teri clearly recalls the first time she wrote a poem. "I was sitting in the Print Shop, looking at a particularly beautiful poster of a mountain. Suddenly, feelings began stirring up inside me. I remember someone telling me that you should write down your feelings, so I did. When I read them over after I'd finished, I couldn't believe that they made sense, much less that the words flowed together well. I finally showed the poem to someone else, who told me he could understand what I was trying to say. I always knew that I could draw and paint, but that was the first time I knew that I could communicate through poetry. Now writing is something I do all the time, so I keep note paper around to allow me to hold whatever words may surface at whatever time. I find that if I don't write them down immediately, they may not recur in just the same way again."

It might seem that tossing off a few lines is easy compared to writing a novel. But Teri doesn't see it that way. The poem "You and I" went through 25 revisions before she was satisfied with it. "I'm always revising," she confides. "I spend hours doing it. Sometimes when I'm working on a poem, an idea will remind me of a poem I've already written. So I go back and look it over again, and usually wind up reconstructing those words for thought. Each revision helps me create alignment between my experiences and the words of the poem. I try to be absolutely accurate about the feelings, while still allowing the words to flow freely."

## You and I

Brother,
I came into this world
and you were there,
You and I
were such a pair.
At the usual times
we would escape
to a place, we hoped
was cause to be late.
Slow down, I'd say
often your shadow,
and over again
you'd just say, follow.
To one another
I had "thought" we belong
but my pretense
that was, has gone.
Left remaining
as it had been
is the love I hold
forever within.

Before "You and I" was finally accepted, Teri had submitted her poems to publishers before and received only rejection slips. Rather than quitting, those criticisms helped keep her creativity high -- and reinforced her persistance.

"I wrote a poem about rejections called 'Empowering Words'," she explained. "Rejection is very energizing for me, because I treat it as a challenge. I think 'oh, you didn't like this one, huh? Well, I'm going to write one that's so good you'll have to accept it!' I've gotten 10 rejections, and they've all made me more determined to keep writing. I also don't take rejection notices personally because I know that the editor simply might not have liked the way the words worked together. After all, he's a professional."

However, Teri admits that face to face critiques of her poems are a different matter. "When I'm face to face with someone who's criticizing my work, I can get pretty touchy! But I keep asking people to read my work, because I have to know how someone else perceives my poems. That's really the only way I can find out if the poem is saying exactly what I want it to say."

Once she discovered poetry, Teri shifted her artistic concentration from painting to poetry. However, she admits to drawing occasionally, "basically to see if I can still do it." She may do some illustrations to accompany "Tears of Illumination," a compilation of 50 of her poems. "The book will cover a transformational period in my life," she explained. "The title is based on the idea that along with the tears shed during the trying times in one's life, valuable insights can show up!"

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Getting a poem published produces a different satisfaction from getting her poems "right." "There is an excitement, a feeling of total inner alignment, when a poem is finished. But getting a poem published -- that's really exciting!"

## All There Is

Where are the moats
surrounding castles
in the air
and dragons breathing fire,
the righteous knight
in shining armor
taking a stand
saving everyone?

All there is
is me.

I am the moat
the hell and fire
a righteous knight
in shining armor,
I touch the sky
the castles there
and slay hungry dragons;
No applause.

All there is
is me.

"When I was notified that my poem had been accepted for the "American Poetry Anthology," I expected the book to be out right away. But it actually took nine to 10 months after I was notified before the book was published. When I opened it, and found out that I was on Page 26 of more than 300 pages, I started yelling and screaming -- even though I was the only one home at the time!"

That excitement stems from a writer's validation by a publisher, according to Teri. "You can have confidence in yourself, and the intuition that you're good. But getting published is like the publisher agreeing with your idea of your ability!"

## Intramural Softball

Heavy hitters are still in demand for PPL's co-ed intramural softball league. Teams will compete every Wednesday night during the 10-week season, scheduled to begin this week.

The intramural league offers an alternative to the travel involved in industrial league play. Games are held on the ball field adjacent to the Forrestal landing strip.

Four teams of 12 players each are needed to get the season underway. Teams members need not be from the same division or department. Interested individuals can call Frank Wasiowicz at ext. 3568 or Ed Bush at ext. 3309 to be placed on a team.

## Employee Safety Reports

Disastrous accidents, such as the Challenger explosion or the Chernobyl nuclear plant fire, graphically focus public attention on safety. Yet safety professionals agree that for every accident that is reported, hundreds of "near-misses" remain undiscovered. The Employee Safety Report (ESR) can prevent these near misses from becoming tragic realities.

Because it comes directly from employees, the information included in an ESR provides candid, detailed information concerning workplace hazards. Workers should use the ESR to describe unsafe conditions or practices that may exist but are not being addressed through normal line organizations. Since safety personnel cannot be everywhere at all times, each ESR plays a vital part in PPL's safety program by collecting and channeling information for safety action followup.

If you have a safety concern that cannot be resolved by your line organization or through your area safety coordinator, fill out a safety report (instructions are printed on the report form). Forms are available in the racks adjacent to the safety bulletin boards throughout the lab. For more information about the ESR, or to get additional forms, contact Peter Del Gandio in the Project and Operational Safety Office (ext. 2806) or Richard Carlese in the Occupational Medicine and Safety Office (ext. 2533).


Get Ready For Barbeques

It's time to get out the grill for the backyard barbeque season. Here are a few safety tips to remember:

- Line the bottom of the clean grill with an inch of

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ash, gravel, or commercial charcoal base to absorb dripping grease and reduce flare-ups.

- Set the grill on a level surface away from low branches, dry brush, or other combustibles -- including the house or garage.
- Follow package directions when using charcoal lighter fluid. Never substitute gasoline or other combustible liquids.
- Never use the grill indoors. Burning charcoal produces carbon monoxide, an odorless, tasteless, lethal gas. Don't bring the grill in after using it, even if the fire appears to be out. Coals that are dry and cold to the touch can still be smoldering inside, giving off deadly carbon monoxide.

**Picnic Ticket Change**
**ADMIT ONE**

**Contrary to the information on the flyer distributed to all lab personnel, Dinah Larsen WILL NOT be selling tickets for the PPL Picnic during June. Anyone interested in purchasing tickets for the picnic, which will be held June 26, should contact Bobbie Cruser at ext. 2101.**

## TRANSITIONS

The HOTLINE offers its congratulations to the following employees, who recently became proud parents:

Kellianne Glasson of the Construction Branch of the Administrative Division, whose daughter, Erin Marie, was born May 2;

Doug Bucknum of TFTR and his wife, Chris, whose daughter, Amanda, was born May 3;

Debbie Shuster of the Computer Division and her husband, Tom, whose son, Eric Thomas, was born May 7;

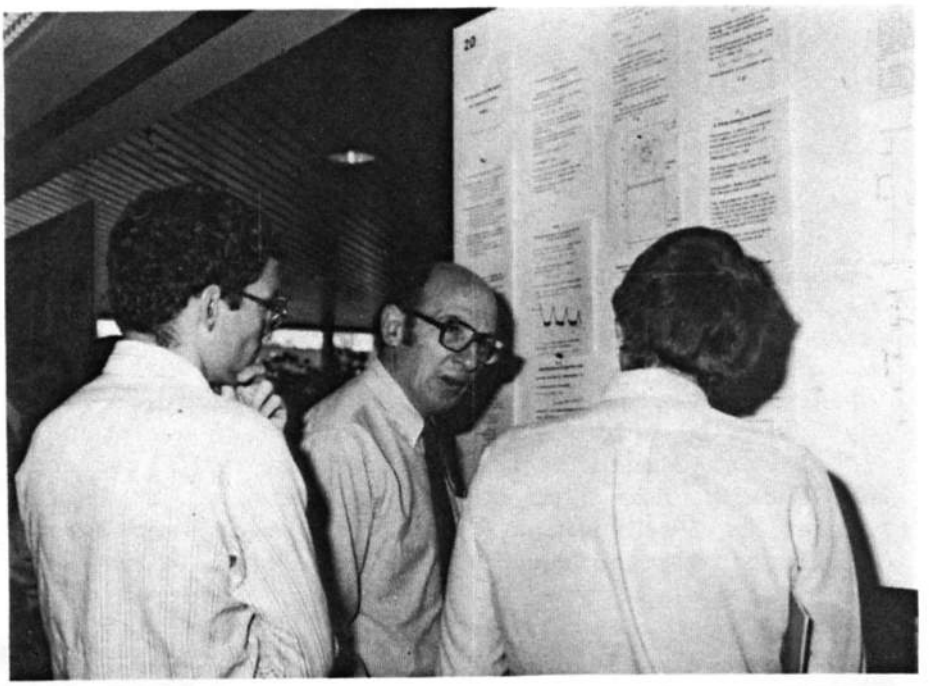
Steven Jurczynski of the Vacuum Section and his wife, Susan, whose daughter, Kristen Lee, was born May 9;

Erik Perry of the Engineering Division and his wife, Isabelle, whose daughter, Rebecca, was born May 19;

Manny Waldman of TFTR and his wife, Janice Marie, whose son, Justin Ross, was born May 19.


*The Fusion Energy Division (FED) of the American Nuclear Society (ANS) presented TFTR Project Manager Dr. Donald J. Grove, left, with its "FED Outstanding Achievement Award" during the May 29 information meeting hosted by PPL. The award honors "exemplary individual achievement requiring professional excellence and leadership of high caliber in the areas of fusion science and engineering." The FED Honors and Awards Committee congratulated Dr. Grove on his "long and distinguished record of providing leadership in design, development, construction, and operation of nearly all US magnetic fusion program "flagship" experiments. Your enthusiasm and boundless energy are, and will continue to be, an inspiration to all of us."*

*Approximately 105 people representing private industry, government, and other fusion research laboratories attended the information meeting hosted by PPL May 29. In conjunction with sessions covering recent research results, 79 posters describing all laboratory experiments to meeting attendees were on display during the one-day event.*



## Energy Department Research Helps in Early Detection of Huntingtons' Disease

"This land is your land...this land is my land...this land was made for you and me..."

Those are the most famous lyrics of folk singer Woody Guthrie, who wrote more than 1,000 songs before his death from Huntington's Disease in 1967. Guthrie may be the best known victim of this inherited disorder of the central nervous system -- but he was not the only one.

Studies suggest that one in every 10,000 persons may have Huntington's Disease, although a lack of reliable information may mask an even greater incidence. It affects men and women alike, occurs most often in middle life, and is fatal -- usually within five to 15 years of onset. Chances are high that if the defective gene occurs in one child, it will also occur in other children born to those parents.

Researchers at Massachusetts General Hospital recently located where this gene occurs in each human cell. Now research is being conducted in a further effort to combat Huntington's and other incurable genetic diseases passed from one generation to another. Work at Los Alamos National Laboratory in New Mexico and Lawrence Livermore National Laboratory in California brings hope that potential carriers of such diseases may be identified early and advised of the risk to their offspring.

Research efforts at Los Alamos and Livermore pro-

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vide the basis for isolating and identifying pieces of human genetic material, which may be "specific" for such genetic disorders.

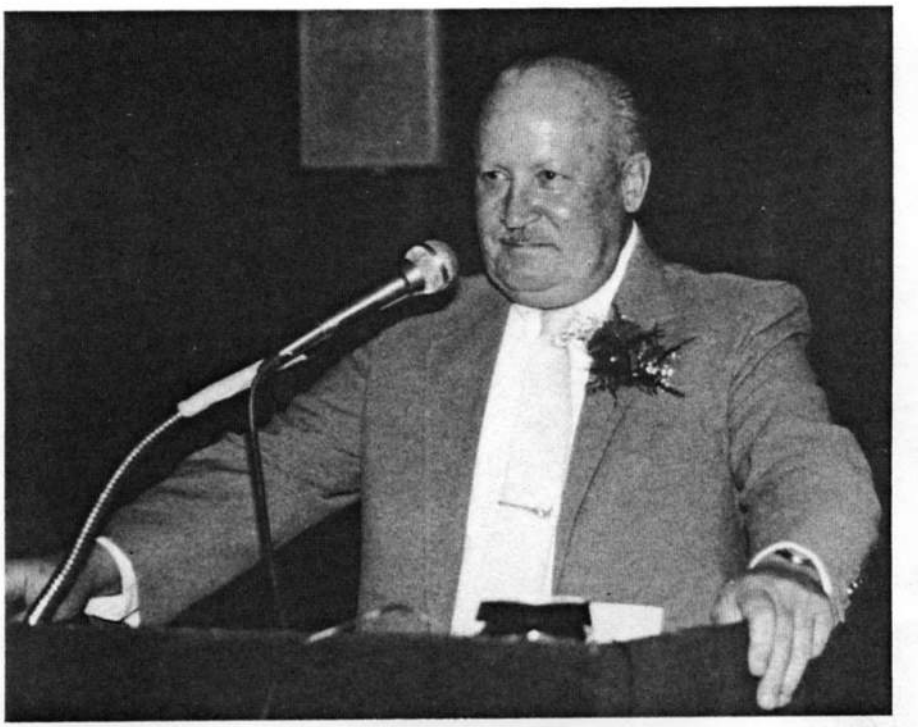
The idea, explains the co-principal investigator Dr. Larry Deaven of Los Alamos, is to build "gene libraries" from each human chromosome. A "library" is actually small pieces of human DNA isolated from a specific chromosome, held in a fluid medium and encased in tiny plastic tubes. The libraries will then be made available to researchers throughout the world who will search through the pieces of DNA and attempt to identify specific pieces which are associated with human genetic disease.

"Many genetic diseases cannot be recognized by looking at chromosomes through a microscope," Dr. Deaven explained. "It is necessary to analyze the genetic material itself -- the material known as DNA."

Once a piece of DNA associated with a disease such as Huntington's Disease is identified, says Dr. Deaven, it becomes possible for doctors to determine whether their patients carry the defective gene by comparing genes from each patient with pieces of DNA obtained from the library. If the defective gene is present, a couple could then be advised that their children would have a high probability of developing the genetic disease. If not, the couple could be freed of worry.

This "gene library" project is another example of how U.S. Energy Department research can benefit us all.


*Mary Ann Brown and Ernie Nieschmidt (right rear) hosted the eight PPL Corporate Award winners from the National Energy Foundation's Student Exposition on Energy Resources (SEER) science fair when they visited the lab April 30. The winners received a tour of the laboratory, a TFTR medallion, and lunch.*



*PPL's Superintendent of Maintenance Ray Pressburger accepted the gifts and congratulations of almost 100 of his co-workers during a retirement party held in his honor at Cedar Gardens April 25. Ray retired after 22 years with the laboratory.*