

## CIT Mission Revised

A revised mission statement for the Compact Ignition Tokamak (CIT) has been issued to reflect better the full potential of the device. The new statement calls for CIT to "determine the physics behavior of self-heated fusion plasmas and demonstrate the production of substantial amounts of fusion power." Based on input from the fusion community, the revised mission statement and goals (see inset) have been approved by the CIT Steering Committee, whose members represent a cross section of the leading fusion research institutions.

Originally the stated mission for CIT focused on ignition to the exclusion of all other physics goals. Early this year it became clear that in the published goals, too little emphasis was being placed on useful physics information that could be gained from high-Q operation. (Q is the ratio of fusion power output to heating power input.) Also, the original statement overemphasized study of the "burn control" aspect of ignition to the exclusion of other important physics studies. In short, the original mission statement gave an "all or nothing" flavor to the range of CIT's expected performance. The

revised mission, while retaining ignition as an objective, focuses on understanding the physics of burning plasmas and on demonstrating the production of significant quantities of fusion power.

The CIT National Design Team is developing a machine design which will provide a toroidal magnetic field strength

of 10 tesla and a plasma current of 11 megamperes (MA) with a 7-second duration. The graph shows the projected CIT performance, along with the range of uncertainties associated with this projection. If the performance of CIT (with an 11-MA current) is projected from existing data, a Q of roughly 25 is expected. A pessimistic

projection yields a Q of 4, and an optimistic projection puts CIT well into the ignited regime. A Q-value in the range of 25 is expected to be ample for the operation of an economical fusion power plant.

In the deuterium-tritium fusion reaction, alpha particles (helium nuclei) and neutrons are produced. The positively charged alphas carry away about 20% of the fusion energy generated. Because they are charged, the alpha particles remain

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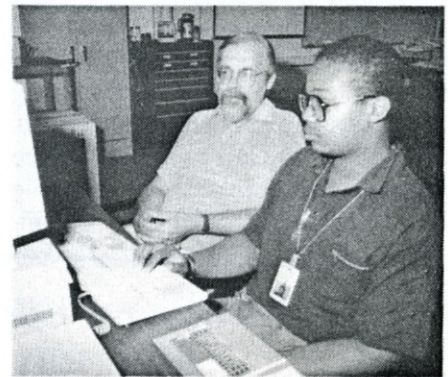
## Reviving an Interest in Science: Part 1

## PPPL Education Programs Help Local Schools

by Ellen Webster

There's a move in this country to take action. We're all guilty of throwing an occasional critical eye at the systems of government, education and even management of our own company, but few of us do anything about the problems.

In 1983 a report called *Nation at Risk* shook up the country when it pointed out a weak link to our future — that of education. It was reported by this and many other studies that our education system was failing us, especially in the areas of mathematics and science. Not only were students



**Willie Smith, a Trenton High School senior, and Jack Abraitis scan for computer viruses.** Photo: JOHN PEOPLES

lacking the necessary background to progress in careers in these fields, but perhaps more importantly, competency in these disciplines was being perceived as unattainable, unnecessary, and utterly boring.

Princeton Plasma Physics Laboratory (PPPL) is now taking a stand on this issue. Beginning this summer, a plan to help make educational improvements at the local level is being put in place.

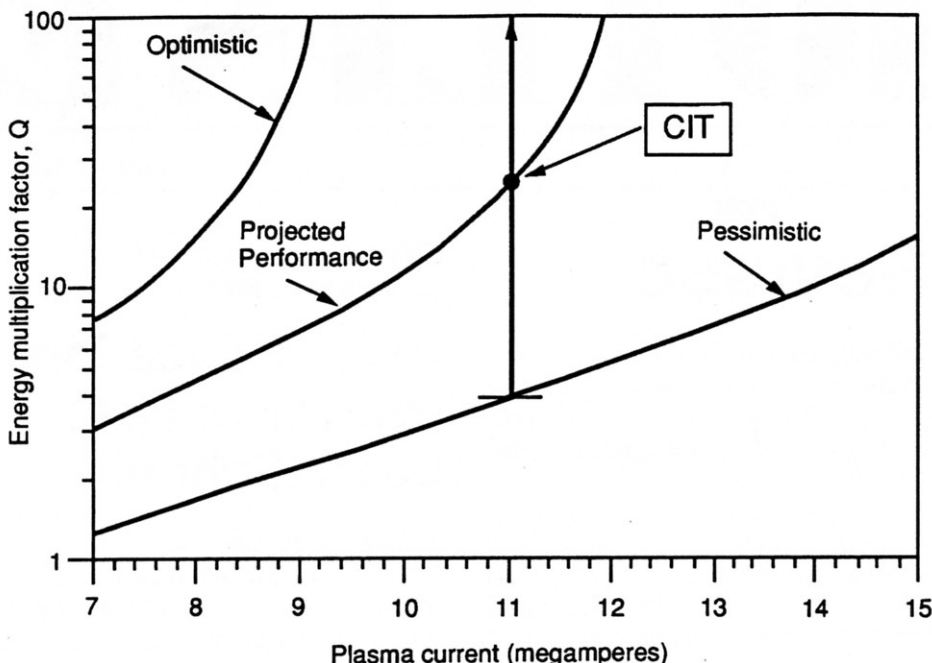
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## Inside

- Student video features PPPL — page 3.
- Someone's been acting up — page 7.
- Classifieds — page 8.







**Compact Ignition Tokamak self-heated regime.**

*CIT continued from page 1*

trapped by the magnetic field and impart their energy to the bulk plasma, helping to keep it hot. The TFTR and JET (Joint European Torus) will explore the region of  $Q=1$  (breakeven), while producing in the range of 30 MW of fusion power. However at that level of performance, plasma self-heating by alpha particles amounts to about 20% of the total heating power. To make good measurements of alpha heating efficiency, a  $Q$  of 5 or greater is required. This new operational regime of self-heated plasmas is the one that CIT is targeted to achieve with a reasonable degree of confi-

dence. As  $Q$  is pushed above 5 toward ignition, physicists will be able to study an expanding range of "burning" plasma operating conditions. Nevertheless, CIT's minimum mission to produce and study self-heated plasmas can be achieved even with the most pessimistic assumptions.

CIT National Design Team members include: Massachusetts Institute of Technology, Oak Ridge National Laboratory, Lawrence Livermore National Laboratory, Idaho National Engineering Laboratory, General Atomics and industry including Ebasco, McDonald Douglas, SPAR Aerospace and Grumman. ▲

## Compact Ignition Tokamak Mission Statement

### CIT Mission

Determine the physics behavior of self-heated fusion plasmas and demonstrate the production of substantial amounts of fusion power.

### CIT Objectives

- Demonstrate the production of fusion power in excess of 100 MW, at fusion-reactor-level power density.
- Determine the confinement physics, operational limits, and alpha-particle dynamics of self-heated fusion plasmas with alpha power greater than auxiliary-heating power.
- Demonstrate heating, fueling, and plasma-handling techniques necessary to produce reactor-level power-density, self-heated plasmas.
- Optimize plasma performance in the range of  $Q=5$  to ignition, with fusion power up to 500 MW.

*Education continued from page 1*

### Education at the Lab

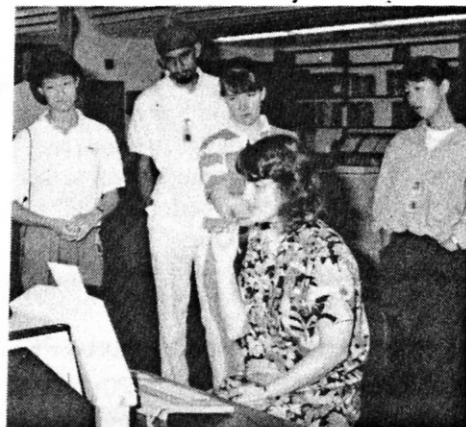
The Laboratory's commitment to education is not new. Graduate and undergraduate programs are offered in plasma physics and materials sciences; the Summer Science Awards provide high-achieving high school students research experiences at the Lab; and Science on Saturday brings students, teachers and parents to PPPL for lectures and demonstrations. The community is invited to our open houses, and thousands of students receive tours each year.

### New Emphasis on Teachers

According to Diane Carroll, recently appointed Head of the Science Education Program, these programs will continue and more are being added. A new emphasis is being placed on teachers as the key to students' interests in science. "It has become apparent that students are excited or turned off to science before they reach high school," she said. "Our goal is to help teachers get students to think about science as something that's fun, that's part of their everyday lives, and as something they can do."

Rush Holt, Assistant Director of PPPL, says that not all students helped by the Lab's programs will become scientists, but all must make daily decisions about science in society, even if by default. "I hope we can help students, both directly and through their teachers, distinguish between astronomy and astrology, between controlled studies in nutrition and fad

*continued on page 6*



**High school students in the Summer Science Awards program are shown library data bases by Jane Holmquist.**

Photo: JOHN PEOPLES

## What's Doing at PPPL?

### PEOPLE

**Charlie Staloff** has been named acting Engineering Department Head.

**Dan Kungl** has been named acting Mechanical Engineering Division Head.

### NOTICES

#### Bulletin Board Clean-Up

The Project Planning & Safety Office asks individuals who post notes on bulletin boards around the Laboratory to remove the notices when they no longer apply.

#### School District Needs Help

The West Windsor-Plainsboro Regional School District is seeking individuals for instructional and noninstructional positions. Contact the superintendent's office at 799-0200.

#### Chemical Transportation from College Road

The transportation of chemicals from 305 & 307 College Road East to new facilities is being coordinated by Scott Larson in the Transportation/Hazardous Materials Branch, ext. 3387. Call to schedule pick-up on August 8, or to make other arrangements.

#### 1990 AIP Style Manual Available

The 1990 fourth edition of the *American Institute of Physics (AIP) Style Manual* is now available for \$10 per copy from Pat Buggs in Information Services. This manual is helpful to physicists and typists preparing manuscripts for publication. It is an excellent source of information on abbreviations, scientific terms, instructions for typing mathematical expressions, and general writing styles including grammar and punctuation.

#### Replacing I.D. Cards

When your shoes wear out, you replace them by getting a new pair. Why not replace your old, worn out I.D. key card, when it becomes cracked? Tape, glue and odd repair only create additional problems for you and our card readers. We can replace your I.D. card in a matter of only a few minutes. Public Safety is on the 2nd floor of the ESU building.

*continued on page 4*

## PPPL Featured in Prize-Winning Student Video

by Ellen Webster

Last February Dale Meade, TFTR Project Manager, received a call from a 15-year-old student who wanted to discuss fusion.

The caller was Jonathan Brenner, the spokesman for a team of high school students about to begin a project for National History Day. This year's theme was Science and Technology in History and, after reading about TFTR, fusion had become the topic they wanted to pursue.

viewed Dr. Meade."

The project took months to complete, and Brenner said that during that time they gained a substantial amount of knowledge about fusion. "We don't know everything, but after six months we're impressed with fusion's benefits," he said.

The 10-minute tape, full of well-written narrative, presents facts and explanations on the evolution of fusion research. The interviews with Meade and footage provided by the Laboratory were interwoven



**V. Mutnick (father of Ian), Mark Klapow, Ian Mutnick (winner in a different category), Jonathan Brenner, Jonathan's father, Dale Meade, Sanjay Pal, Salim Massoud, and Erik Carpenter.**

Photo: JOHN PEOPLES

Months later it is easy to see that not only was that call successful, but so was the documentary they produced, *Thermonuclear Fusion: The Dawn of a New Epoch*. The five-student team from Westhill High School in Stamford, Connecticut won the local contest, went on to take first in the state, and competed nationally in Washington, D.C.

Dale said he responded to the initial call because "Jonathan was persuasive, and I wanted to help anyone who was that interested in fusion."

And the enthusiasm worked both ways. "Dr. Meade was very helpful," said Jonathan. "We spent an entire day at the Lab, had a tour, video taped TFTR, and inter-

viewed Dr. Meade."

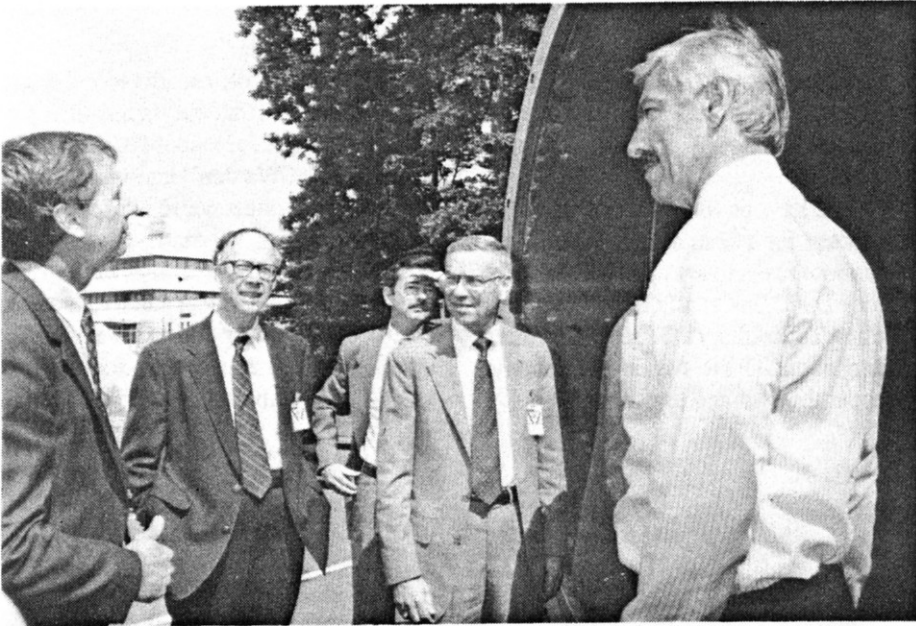
throughout the tape and used to clarify historical data and explain fusion processes.

PPPL's own history was documented, as was the relevance of the oil embargo in the '70s which created popular interest in alternative energy sources and as such, became a catalyst for fusion's funding to be stepped up sixfold during that time period.

Recently the five young documentarians, Jonathan Brenner, Erik Carpenter, Mark Klapow, Salim Massoud and Sanjay Pal, once again visited the Lab. They proudly presented Meade with a copy of the tape, the end result of a phone call made several months ago. ▲

# What's Doing at PPPL?

What's Doing continued from page 3



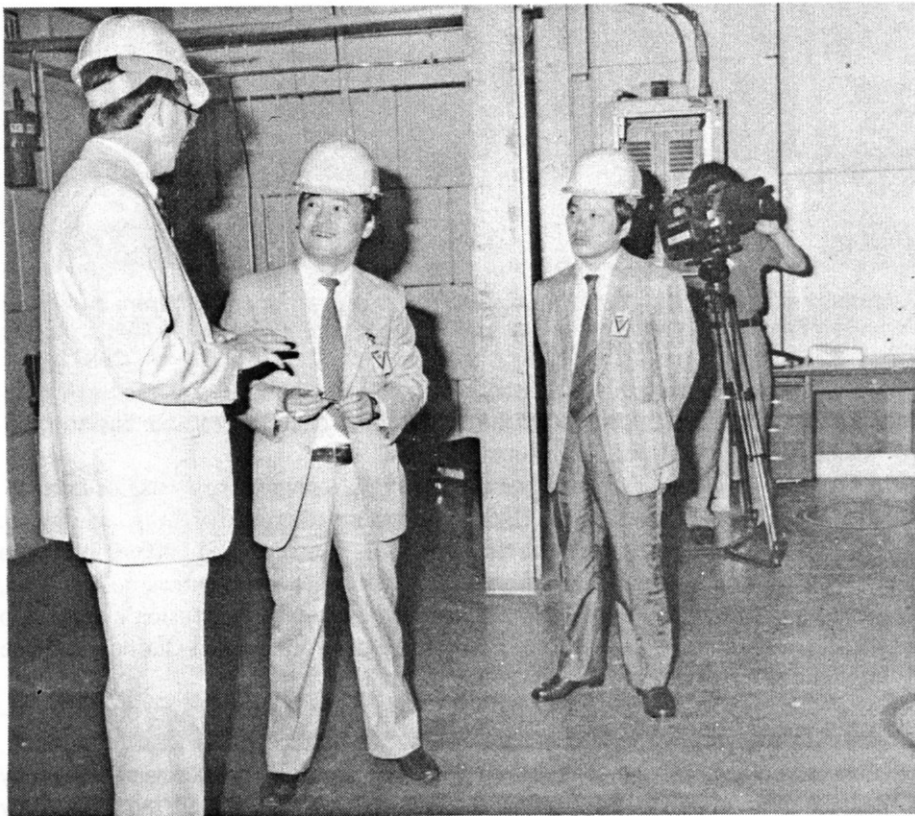
**Visitors from the National Aeronautics and Space Administration (NASA) were given a tour TFTR by Dale Meade on June 14. Discussions included PPPL experiments and the possible use of He<sup>3</sup> in the U.S. Fusion and Space Programs.**

Photo: JOHN PEOPLES



**Princeton University President Harold Shapiro presented a colloquium describing the President's [President Bush] Council on Science & Technology in Gottlieb Auditorium on June 21.**

Photo: JOHN PEOPLES



**A film and reporting crew preparing a documentary for the Korean Broadcasting System (KBS) visited PPPL and interviewed Doug Post on June 28.**

Photo: JOHN PEOPLES



**An informal gathering to honor Jack Joyce's retirement was held on June 29.**

Photo: JOHN PEOPLES



# Scrap Metal Recycling Program

by Ray Camp

Everybody knows that the Laboratory recycles paper, but did you know that we have another recycling program? One that earns money? It's the scrap metal recycling program, overseen by Matt Lawson of Property Administration.

The program centers on those metals we use most: aluminum, copper, stainless steels, tin steels (mostly sheet metal) and wire. The return we get, set by contract scrap prices, can range from \$1.30 per

pound for clean copper to under a half cent per pound for mixed tin scrap.

According to Lawson, the key to getting the most for our scrap metals is keeping them separate. To do this, scrap metal bins are clearly marked as to their types. The bins are conveniently located at D-Site, behind FCPC; by the fence across the street from the RESA building; and behind the old tech shop by the radio-frequency trestle. (See illustration.)



**Matt Lawson oversees the scrap metal recycling program.** Photo: JOHN PEOPLES

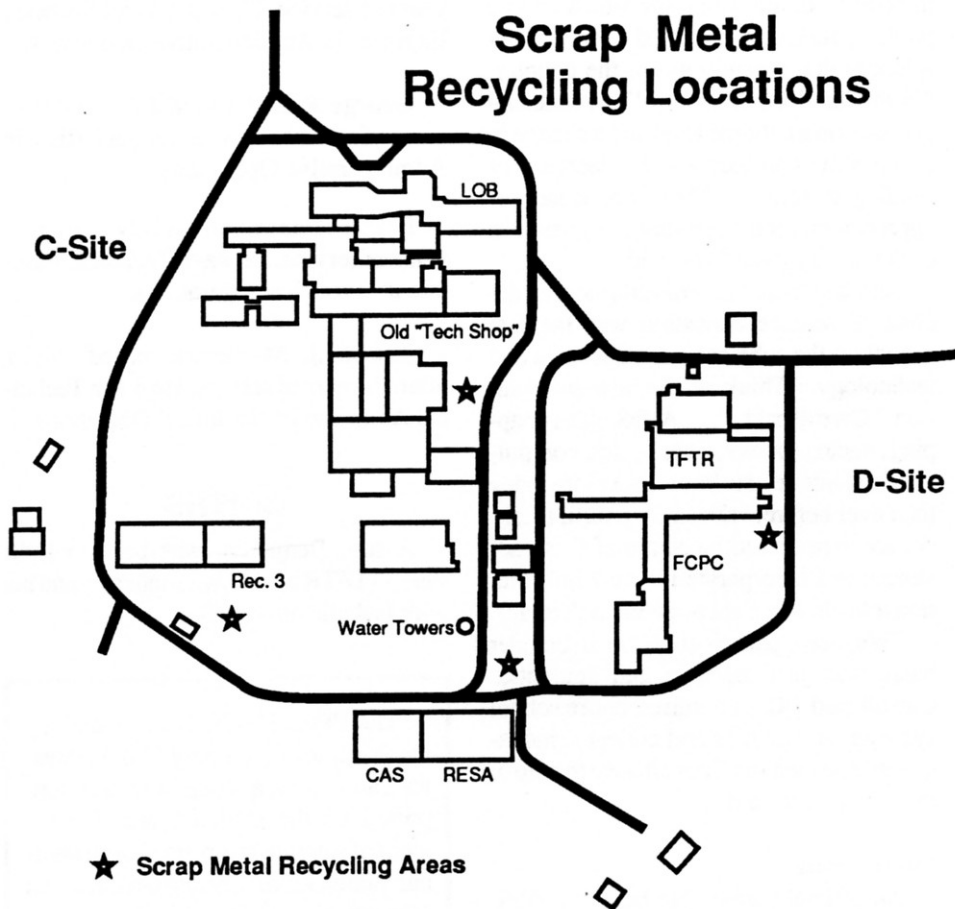
If you need to scrap a large quantity (100 pounds or more) of something unusual, like a specialty steel or coaxial cable, give Matt a call. It may make more economic sense to have a special pickup.

Whenever you put scrap metals into the hoppers, keep these simple rules in mind:

- **Separate**  
Mixed scrap gives the lowest return.
- **Keep It Clean**  
Skids, reels, trash, etc., reduce the scrap value and can be dangerous to remove.
- **No Appliances, Gas Cylinders or Storage Drums**  
Gas cylinders and storage drums should be cleared through the Safety Office (Bill Slavin, ext. 2533) and the Hazardous Materials Office (Scott Larson, ext. 3387), respectively. Appliances should be excessed or trashed.

If you have questions or need help, call Matt Lawson at ext. 2716 or pager 550.▲

## Scrap Metal Recycling Locations



**Belated congratulations to those who completed the first college credit course in Administrative Office Management offered at PPPL. Twenty employees participated in this series of classes which was offered by Mercer County Community College as part of the Employee Development Program.**

Photo: MIKE DIONNE

diets, between extravagant claims for some military technology and more solid scientific work," he said. "Many of us at PPPL, not just scientists and engineers, have much to contribute to this effort."

This summer two new education programs will help teachers with basic physics concepts as well as practical projects and demonstrations they can take back to the classrooms:

On July 2, the PPPL Teacher Research Associate Program began; eight high school teachers started apprenticeships with Laboratory scientists and engineers.

Carroll said this six-week program had its beginning when discussions with teach-

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***"Many of us at PPPL, not just scientists and engineers, have much to contribute to this effort."***

***— Rush Holt***

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ers revealed that they had an interest in gaining experience in a research environment. "The focus of the program" she said, "is on showing teachers how science is done — letting them participate in the day-to-day life of a research laboratory. To us this may not seem so extraordinary, but it is to them. Teachers say that they need to help prepare students for science in the 'real world.' They say they need help finding out about new developments in science and need accurate information to help guide students' career choices."

The Summer Teachers' Institute is bringing teachers from sixth, seventh, and eighth grades to the Laboratory for two weeks from July 9 to 20. The model for this pilot program is the American Institute of Physics' *Operation Physics*, which is based on the concept of teachers teaching teachers. The workshops will use lots of hands-on projects to show students the relevance of science in their lives.

#### **Nation-Wide Cooperation Called For**

The idea of targeting teachers is being adapted nation-wide. In October of 1989 a conference was hosted by the DOE for the purpose of designing a national plan to

help federal research facilities expand their education programs. The results of this meeting included an agreement to provide kindergarten through high school students with a strong technological foundation on which to base their future education in science and math, and to furnish science and math teachers with "in-depth state-of-the-art training" so their teaching can "spark students' interest and understanding."

#### **The Roots of the Problem**

Carroll said the Lab's programs are intended to help remedy the current crisis in education, the blame for which can be partially attributed to a broad attitude about sciences that recently swept the country. "In the late '60s and early '70s, financial pressure on a national level and a change in social values influenced the decrease of funding to science. There was a lack of appreciation for the relevance of science in our everyday lives," she said.

Another factor contributing to the decline of science education was the fast growth in the subject areas of science and technology. "Think of the new information," Carroll said. "... AIDS, gene-mapping, nuclear power, fiber optics, computers. Students need to know a lot more today than ever before," she said. In turn, teachers are expected to be aware of these advances and incorporate the new information into already tight academic schedules.

"We need participation on a broader basis than just teachers and students," Carroll said. "Communities, entire school systems, universities and colleges, industry and research facilities all have to help in the effort," she said.

#### **Future Plans**

An official partnership between PPPL and the Trenton School District is currently in the works and may be in place by fall '90. Plans include helping a Trenton junior high science magnet school outfit its science laboratory, sending Laboratory personnel to talk with classes, providing career guidance in science and engineering, offering students special tours, and setting up a mentoring and tutoring program where employees with expertise in many areas can participate. ▲

*In the next issue: A look at who's attending PPPL's summer schools.*

## **TRANSITIONS**

### **RETIRED**

**Charles E. Beach, Jr.** retired July 1 after 27 years of service. He was a Technical Associate in Technical Operations.

**James M. Beach** retired July 1 after 31 years of service. He was a Technical Assistant in Technical Operations.

**Henry Fallon** retired July 1 after 25 years of service. He was a Lead Software Engineer in Administrative Operations.

**George F. Hill** retired July 1 after 15 years of service. He was Budget Officer in Administrative Operations.

**Frank Homan** retired July 1 after 33 years of service. He was a Technical Associate in Technical Operations.

**Joseph J. Mayercak** retired July 1 after 30 years of service. He was a Technical Associate in Technical Operations.

### **BIRTHS**

A son, Benjamin, was born to Erik Perry (TFTR Shutdown Manager) and his wife Isabelle on June 26.

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Reproduction: Teri Daynorowicz  
and Dan Klingner

# Learning About Life Through Theatre

by Ellen Webster

It was during a lunchtime break from rehearsals for *The Glass Menagerie* that Maureen Stapelton taught Don Bumgardner to eat an artichoke.

At that time Bumgardner was the stage manager for the Broadway 20th anniversary revival of the show. He said that the cast and crew went to a small French restaurant, and having never experienced the art of artichoke consumption, Ms. Stapelton offered to teach him. When asked to describe the lesson he said with a bit of hesitation, "Oh well, it was . . . ah . . . all visual."

And while consuming artichokes may have been new to Bumgardner, a Telecommunications Assistant and employee of PPPL for six years, the world of theatre wasn't. He graduated from Michigan State University with a degree in Speech and Drama and over the years has been active in nearly 100 productions.

"I got involved with theatre because I was a shy individual and it gave me a chance to do things as another character that I wouldn't necessarily do as myself,"



he said. "It gave me a means of expression."

Theatre filled much of Bumgardner's life prior to coming to PPPL. "I tried to make a career of working in professional theatre," he said, "but I found that I like to eat regularly." For many years he maintained work outside of theatre to sustain himself — for such things as food and mortgage payments — but continued to be involved with theatre. Since coming to the

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**—Don Bumgardner**

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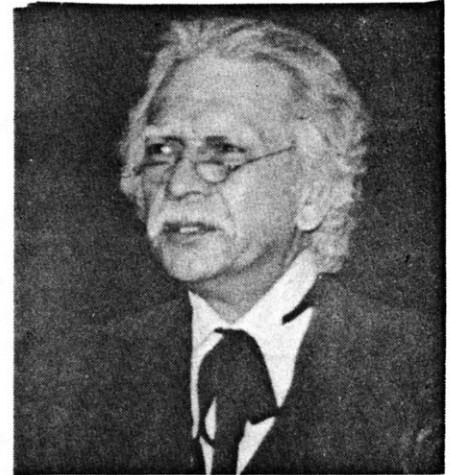
Lab, however, he has had less of a desire to lead that dual life. "Somehow at the Lab I can balance making a living and keeping my sanity. Besides that, in my 'declining years' I've become more selective in how much time I feel I can give to an avocation. Theatre, to be done right," he said, "is all consuming."

When reminiscing about his life in theatre, Bumgardner recalled more about Maureen Stapelton. "I found her to be an absolute delight — so filled with love and, in my estimation, very close to a genius in her field. And being close to genius," he said, "she has a lot of hang-ups."

"While working with her I learned very early on that one of her phobias while on stage was that any strange, unexplained noises might cause her to just leave the stage. I'm not sure where the fear came from, but one of my jobs was to move as quickly as possible behind her and explain what the noise was."

He recalled a favorite acting role as that of the theatre owner in the

Crossroads Theatre Company production of *One Mo' Time*. Crossroads, nationally renowned for producing quality plays that have a particular relevance in black culture and heritage, is located in New Brunswick. Bumgardner played the part of the theatre owner and remembers it as a "wonderful



experience" because of the professionalism of both the theatre and his fellow actors.

In addition to acting and stage managing, Bumgardner has also designed for theatre. He won an award for best set design for *Daughters* at the Edison Valley Playhouse.

Regarding acting again, he said, "If a script comes along that I feel is right for me and if I feel the production as a whole has value, I would definitely consider trying to get involved." He prefers roles that are considerably different from his own personality. "I find it difficult to be myself in a performing situation," he said.

And what type of play might woo him? "It would have to be a play that has definite social significance while at the same time being entertaining. I tend to shy away from light frothy diversion. While they have a definite place, there're not my favorite."

Bumgardner encourages theatre attendance and says that it can be a healthy diversion from one's own perspective and lead to personal discovery. "Theatre can help show you how you feel about life. It can cause people to question others' values and expand their own sense of understanding." ▲



# Safety Courses

The Safety Office has scheduled the following safety training courses for July.

Course	Date/Time/Location
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## Radiation Safety Training

23-25 July, 8:30-12:30  
D-Site, Safety Office

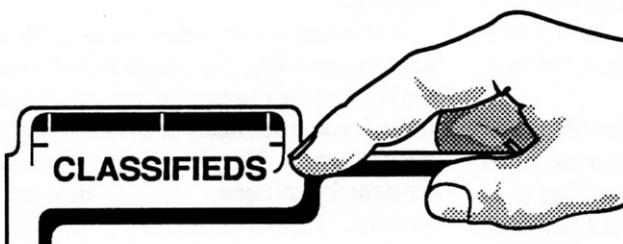
This course is required for all who must enter a radiation area.

## Basic Electrical Safety

25 July, 3:00-4:00 p.m.  
D-Site, Safety Trailer

This course reviews: the effects of electricity on the human body, energy sources, conversion and modification equipment, energy storage devices, energy uses, conductors, protective procedures, wiring methods, devices and tools, and emergency procedures. It is required for all employees working in the electrical field.

Employees must obtain permission from their immediate supervisor to attend these classes. Supervisors should call Sue Hill at ext. 2526 to enroll their employees.



## FREE

### Needs a Good Home

A two-year-old fixed black cat named Charlie likes children and needs a good home. Call Eric, ext. 3176.

## FOR SALE

### Pick Your Own

Used red paving bricks, 25¢ each. Approximately 3,000 total. Call Marilyn, ext. 2656.

### Dog Run

A 9"W x 12"L x 5"H carrier. \$150. Call Marilyn, ext. 2656.

### '84 Dodge Daytona

Turbo, 5-speed leather interior, 34,000 miles. \$2,500 OBO. Call Marilyn, ext. 2656.

### Physical Fitness Equipment

Bio Dyne universal gym, Nordic Track cross-country ski machine, stationary bicycle, and sit-up board. Will sell separately or as package. Call ext. 3048.

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