BROOKHAVEN BULLETIN
Vol. 38 - No. 48 December 14, 1984
BROOKHAVEN NATIONAL LABORATORY

Preventive Medicine for Photovoltaics

When consumers first discovered solar cells, they were attached to novelty items, calculators and watches. Now, those cells, called photovoltaic devices because they turn sunlight into electricity, are appearing on the marketplace for serious energy applications. By the turn of the century, if prices continue to fall, photovoltaics could become a viable alternative to conventional energy systems, including coal and nuclear power plants.

Keeping pace with the rapidly developing photovoltaic technology is a unique program at BNL to insure that public and occupational health and safety are not endangered as new materials, production processes and applications are explored and commercialized.

Working on this project are Paul Moskowitz, Vasilis Fthenakis, John Lee and Leonard Hamilton, of the Biomedical and Environmental Assessment Division (BEAD) in the Department of Applied Science. They are funded by the Photovoltaic Energy Technology Division of the U.S. Department of Energy, which actively supports research and development to increase device efficiency and reduce costs.

Moskowitz likens their work to good preventive medicine. He notes that photovoltaic devices can be made from various processes and materials, some of which could possibly endanger health. "Careful analysis of these problems before commercialization can permit system designers to avoid future problems which could adversely affect the cost competitiveness and public acceptance of these systems," he says.

The problems Moskowitz refers to include potential chemical and physical hazards to workers manufacturing the devices, as well as to potential public health risks from pollutants emitted throughout the energy cycle, and from physical hazards related to the installation and maintenance of photovoltaic systems on homes (several kilowatts) or at large power plants (1-100 megawatts).

Photovoltaic Devices

The first large-scale use of photovoltaics in the U.S. was for the space program. These devices, made from single crystals of silicon, were quite expensive, but because of their unique application, the cost did not limit their use. In the mid-1970's, sales to terrestrial markets began, and at present, these sales dominate. In an attempt to expand sales, researchers and manufacturers are developing cheaper alternatives including polycrystalline silicon and thin film devices using special materials such as polycrystalline gallium arsenide, copper indium diselenide, and amorphous silicon. (Amorphous silicon devices are being studied at BNL. See Bulletin, June 22, 1984.)

Production

BEAD has examined processes representative of existing and future technologies.. Current work focuses on the production of thin film devices which are just emerging on the market. Because many production processes are still only experimental, BEAD's analyses are often based on surrogate data from the semiconductor and electronic industries, as well as data from researchers at other Federal laboratories and the private sector.

For each specific device, the group identifies the different steps taken in its manufacture. To collect the right information, they ask questions such as: What is the structure of the photovoltaic cell? What type of equipment is needed? What materials are needed? Are the materials toxic, flammable or explosive? How are they stored? What types and quantities of waste is the process likely to produce? How do workers interact with equipment? What kind of occupational or environmental regulations exist for similar processes? In the absence of existing regulations, what controls would be prudent and how much would they cost?

The answers to these and numerous others questions form the basis for an assessment of risks from the technology. Analyses completed to date suggest that application of the proper safeguards can minimize potential chemical and physical hazards from the manufacture of these devices.

Installation, Use and Disposal

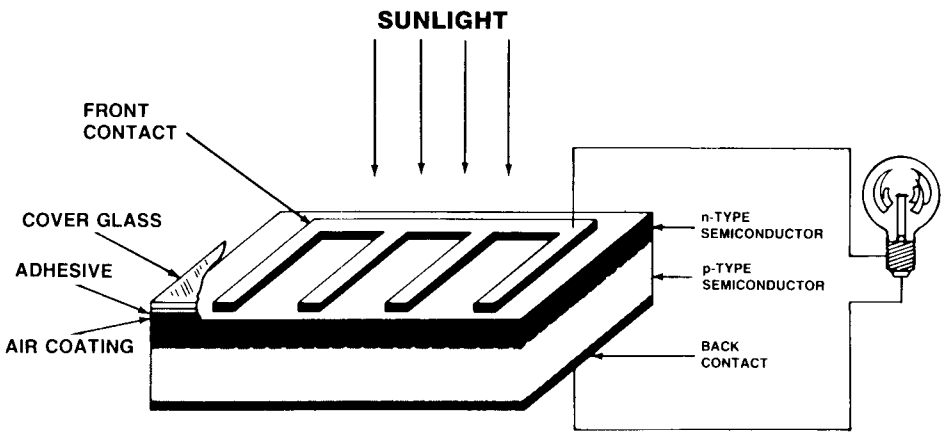
The group has also looked at the risks associated with the devices once they leave the factory. For instance, while photovoltaics are thought to have low electrical output, the voltage generated by even a small house system could be hazardous. BEAD strongly supported the efforts of the Department of Energy to obtain UL certification for these devices.

Disposal of spent or decommissioned photovoltaic devices is another concern. Some of the devices contain toxic materials such as cadmium and arsenic, and risk from disposal needs to be studied.

Insurance for the Future

Photovoltaic systems are just beginning to make inroads into the large energy market. On the West Coast, several central-station systems (each about one megawatt) have been installed, and the industry is optimistic about future sales for private residences. As the market grows and the technology matures, the BEAD program hopes to insure that the final production processes, devices and applications are safe to workers and to the public. These efforts will support the commercial viability of this promising technology.

— Mona S. Rowe



A typical flat plate solar cell contains a layer of semiconductor material. When sunlight strikes the cell, electrons are freed in the semiconductor material, and an electric current is generated. The electricity is collected and carried by metallic contacts placed in a grid-like fashion on the surface of the cell. Thin film devices work in a similar fashion, except they use a thinner layer of a more light absorbing semiconductor.

Peter Horton

From left, Vasilis Fthenakis, Paul Moskowitz, Leonard Hamilton and John Lee review data used to evaluate health risks of photovoltaic devices.

Patent Awarded

Richard A. Sapienza, William A.R. Slegeir, both in the Department of Applied Science, and **Michael J. Sansone**, a former BNL employee, were jointly issued U.S. Patent #4,460,710 for developing a method for synthesizing hydrocarbons from carbon monoxide and hydrogen in the presence of a catalyst, commonly known as the Fischer-Tropsch synthesis. Fischer-Tropsch synthesis, wherein liquid aliphatic hydrocarbons, alcohols and minor amounts of aldehydes, fatty acids and ketones are produced by the hydrogenation of carbon monoxide, was developed about 60 years ago. Initially, alkalized iron turnings were utilized as the catalytic material.

Numerous attempts have been made to refine this synthesis in terms of improved effectiveness of the catalyst, product yield, improved production of more desirable product fractions, control of the product distribution, and so on. Additional efforts have been made to achieve more stable catalysts.

The novel catalytic material discovered by Sapienza, Slegeir and Sansone is unique in its physiochemical constitution as well as the properties it exhibits. For example, the material exhibits superior activity as compared to conventional Fischer-Tropsch type catalysts; such activity can be obtained in dilute slurry form, which substantially improves the heat transfer factors involved in the synthesis; and it has superior stability and can be stored for long periods of time in either a dry or slurry form.

The new catalyst is a slurry composed of palladium or platinum and cobalt supported on a solid phase. The catalyst is prepared by heating a heterogeneous component of the palladium or platinum deposited on the solid support in a solution of cobalt carbonyl or precursors thereof.

For Good and Reasonable Science

Just as each floor of a skyscraper is built upon ones beneath it, new scientific discoveries are built upon previous findings. And if weakness exists at any level, the structure or the science could come tumbling down. That's why, explained assistant director Jerry Hudis, the world of science is very careful that "what goes into the scientific literature is good and reasonable science."

To ensure this, submissions to research journals are carefully reviewed. For these reviews, journal editors turn to other scientists, generally those who have already published in that field. "Most journals depend on having reviewers who, with the blessing of anonymity, give their scientific opinions on the papers being considered for publication. That's the beauty of the system," said Hudis.

As scientists advance their careers and become more prominent in their fields they may be asked to trade the anonymity of reviewers for more public positions as journal editors or as members of advisory or editorial boards. These are honorary positions, and about 10% of the people on BNL's scientific staff are currently engaged in such endeavors (see accompanying list).

But why should they take on these additional and obviously time-consuming responsibilities? "It's a mark of recognition by your scientific peers," Hudis said. "Further, being an editor means that you're carrying part of the responsibility for being sure that what has gone on before is correct. Science is somebody doing an experiment, writing it up, interpreting its results and publishing it in enough detail that another scientist can do the same thing and come out with the same answer. That's why you often see people repeat an experiment. Scien-

(Continued on page 2)

Editors (Continued)

tists basically depend on what's gone on before."

BNL has some areas where scientists concentrate on doing experiments and others where they concentrate on helping experiments get done. This accounts for differences in the numbers of people in the various departments and divisions who appear on the accompanying list. As Hudis explained, "In the AGS Department, for example, people are involved in large part in building and designing machines. Most of their work is recorded in internal notes or in papers given at conferences, rather than in research journals. For chemists, on the other hand, that's their bread and butter. Everything they do is going to be published in one of those journals."

The listing was compiled from records currently on file with the different departments and divisions. Any corrections should be reported to the appropriate offices.

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Key to Positions: AB, Advisory Board; AE, Associate Editor; ASE, Associate Science Editor; CE, Co-editor; EAB, Editorial Advisory Board; EB, Editorial Board; Ed., Editor; GE, Guest Editor; SC, Series Coordinator; SCC, Steering Committee Chairman.

Name	Dept.	Pos.	Publication
Sujit Banerjee	S&EP	EB	Environmental Toxicology & Chemistry
Jerome Barancik	DAS	Ed.	Journal of Safety Research
Mark Barton	NSLS	EB	Nuclear Instruments & Methods
Michael Bender	Med.	EB	Mutation Research
		EB	Radiation Protection Dosimetry
John Bennett	Bio.	EB	Photochemistry & Photobiology
Martin Blume	DO	EB	Transport Theory & Statistical Physics
		AB	Science
		EB	Nuclear Instruments and Methods and Physics Research
Victor Bond	Med.	EB	Environment International
Donald Borg	Med.	EB	Reviews of Nuclear Science
		EB	Journal of Free Radicals in Biology & Medicine (first edition 1985)
		EB	Advances in Free Radicals in Biology & Medicine (first edition 1985)
Bertrand Brill	Med.	Ed.	Transactions of Medical Imaging
		EB	Journal of Physiologic Imaging
Ben Burr	Bio.	EB	Genetics
W. Robert Casey	S&EP	AE	Health Physics Journal
Peter Columbo	DNE	EB	Nuclear and Chemical Waste Management
Ernest Courant	HEF/ Phys.	Ed.	Particle Accelerators
David Cox	Phys.	Ed.	Journal of Physics & Chemistry of Solids
Eugene Cronkite	Med.	EB	Research Communications in Chemical Pathology and Pharmacology
		EB	Blood Cells
		EB	Leukemia Research
		Ed.	Experimental Hematology
George Dienes	Phys.	CE	Journal of Physics & Chemistry of Solids
		EAB	Radiation Effects, Letters Section
		CE	Molecular Crystals & Liquid Crystals, Letters Section
Robert Drew	Med	EB	Toxicology and Applied Pharmacology
		EB	Fundamental and Applied Toxicology
		EB	Toxicology and Environmental Health
		EB	Environmental Health Perspectives
Victor Emery	Phys.	EB	Journal of Low Temperature Physics
Paul Falkowski	DAS	Ed.	Journal of Phycology
Anthony Fresco	DNE	Ed.	ASME Limelight, L.I. Section
George Greene	DNE	Ed.	Heat Transfer — Japanese Research
Leonard Hamilton	DAS	Ed.	Renewable Sources of Energy
Garman Harbottle	Chem.	AE	Archaeometry
		AE	Radiochemical and Radioanalytical Letters
George Hendrey	DAS	Ed.	Northeastern Environmental Science
Andrew Hull	S&EP	AE	Health Physics Newsletter
Richard Lambrecht	Chem.	EAB	Nuclear Medicine Communications
		AB	Journal of Radioanalytical and Nuclear Chemistry
William Marciano	Phys.	ASE	Physical Review Letters
Robert Marr	AMD	EB	Magnetic Resonance Imaging
Samuel Morris	DAS	Ed.	Environment International
Paul Moskowitz	DAS	AB	CRC Press
Leonard Newman	DAS	AB	Environmental Science & Technology
Marshall Newton	Chem.	AB	Journal of Physical Chemistry
William O'Grady	DAS	Ed.	Electrochemical Society
Martin Plotkin	HEF	SCC	Transactions on Medical Imaging
James Powell	DNE	AE	Journal of Fusion Energy
Morris Reich	DNE	EB	Journal of Nuclear Engineering & Design
Gilbert Rowe	DAS	Ed.	Journal of Marine Research
		Ed.	Biological Oceanography
		Ed.	South African Journal of Marine Science
Jane Setlow	Bio.	EB	Journal of Bacteriology
Richard Setlow	Bio.	EB	Environmental Mutagenesis
		EB	Mutation Research
		EB	Mechanisms of Ageing & Development
Sharon Smith	DAS	Ed.	Limnology & Oceanography
Lewis Snead	DAS	Ed.	Physical Review
Meyer Steinberg	DAS	Ed.	Energy Sources
William Studier	Bio.	EB	Journal of Virology
Andrew Sunyar	Phys.	AE	Atomic Date & Nuclear Data Tables
Betsy Sutherland	Bio.	EB	DNA Reports/Mutation Research
John Sutherland	Bio.	AE	Photochemistry & Photobiology
Norman Sutin	Chem.	AB	Journal of the American Chemical Society
Ignatius Tang	DAS	EB/ AB	Aerosol Science & Technology
William Thomlinson	NSLS	GE	Nuclear Instruments & Methods
Arie van Steenbergen	NSLS	EB	Particle Accelerators
Jack Van't Hof	Bio.	EB	Environmental and Experimental Botany
James Vaughn	DAS	Ed.	Northeastern Environmental Science
George Vineyard	Phys.	Ed.	Physical Review Letters
		EAB	Physics & Chemistry of Liquids
Ernest Warburton	Phys.	AE	Physical Review Letters
Joseph Weneser	Phys.	AE	Reviews of Modern Physics
		SC	Comments on Modern Physics
Gwyn Williams	NSLS	Ed.	Vacuum Magazine (North American edition)
		GE	Nuclear Instruments & Methods
Alfred Wolf	Chem.	Ed.	Radiochimica Acta
		Ed.	Journal of Labelled Compounds and Radiopharmaceuticals
Wolfgang Wulff	DNE	AB	Nuclear Engineering Design

Roger Stoutenburgh

Ray Davis inspects "treasure" recovered from sunken ships — two tons of lead, occupying about one-third of a cubic yard of space in a corner of the Chemistry Department basement.

Sunken 'Treasure' Aids Research

In the early sixteenth century, the seas were dominated by searches for new worlds and simpler passages to exotic ports. But for every successful exploration, there were several that failed. Attacked by pirates or beset by storms, many ships were swallowed by the sea.

Most of those vessels have lain undisturbed in their watery graves. But at least one ship that sank in the early 1500's has been salvaged, and part of the booty ended up in the Chemistry Department — not doubloons or pieces of eight, but lead.

This lead, said chemist Ray Davis, "is a very valuable thing to have in the scientific community." Davis, who was a senior chemist at BNL until his retirement last month, explained that the lead's value lies in its age. "Lead that has just come out of the mine has a little lead-210 in it, from uranium that's in the ore. Lead-210 is an isotope with a 22-year half life. Over time, then, the lead-210 will decay and disappear from the lead, leaving the lead relatively pure."

Scientists believe that pure lead is desirable as shielding for low-level counting. Because this process involves the measurement of very small amounts of radioactivity, it is important that the lead shielding be free of radioactivity. To meet this requirement, Davis explained, researchers usually buy new lead that is low in lead-210, from a Department of Energy mine in Missouri. And to obtain even purer, older lead, some scientists have looked to lead-roofed cathedrals under renovation, offering to trade the old lead for new.

In 1962, several bars of lead, weighing about one ton, from a Dutch vessel that went down in the North Sea around 1874 "were kind of up for grabs," Davis recounted, "so we asked for it, thinking, 'right now we can't use it, but we'll have it, just in case.'" The same reasoning prevailed in 1970, when an even older treasure became available — 1.5 tons of lead ballast from a Spanish boat shipwrecked off Puerto Rico in 1538.

Two tons of lead (one from each ship) were stored in the basement of the Chemistry Department; the other half ton from the Spanish ship was given to the Physics Department. But no one at Brookhaven ever needed the lead, and most people seemed to forget about it.

In the meantime, Davis initiated an experiment about one mile down in the Homestake Gold Mine in South Dakota. The world-famous experiment, which detects and measures neutrinos from the interior of the sun, had a startling result, measuring about one fourth the number of electron-type neutrinos predicted by the accepted theories of stellar structure and stellar evolution.

The success of Davis' experiment in eliminating background that might be encountered in studies on the surface of the Earth has lured others down into the mine to do research. Today, four experiments are set up in the special area blasted out of the operating gold mine. In addition to Davis' study, teams from the University of Pennsylvania and the Smithsonian Institute are taking cosmic ray measurements, and a group from the Battelle Pacific-Northwest Laboratory is doing an experiment to observe double beta decay of germanium-76.

The Battelle study, Davis said, "involves using a large, specially prepared, germanium crystal, like the ones commonly used for high resolution gamma counting. They're trying to get the lowest possible background counting rate. They're deep in the earth, and they have the detector in a very good shield, but they still have some residual background. They've tried shielding of iron, copper and lead. They've used the best lead available, and they still find that the lead-210 content limits their experiment.

"So I told them we have some old lead at Brookhaven," Davis continued, "and they made a deal for a trade with us. They would take this lead off our hands and give us the equivalent in high quality lead."

Arrangements are not completed for the transfer of the lead, but Davis expects that the Battelle researchers will have it before the end of the year. "They've purified and counted a small piece," said Davis, "and all they can say is it's very good lead, but they can't say it's any better than the lead they already have until they clean the rest of it, cast it into bricks and put it around their experiment. And that's an expensive proposition."

But Davis is glad they're doing it. "I'm pleased that someone will take this lead and put it in usable form. Then, of course, when that experiment's over, it's available to other people."

When the lead finally completes its transition from the bottom of the sea to the bottom of the Earth, Davis is likely to be on hand to witness its success or failure. For though he has officially retired from the Laboratory, he still comes to BNL as a research collaborator and plans to work on the continuation of his experiment at the mine.

Inside Info

Martin Plotkin has been elected a Fellow of the Institute of Electrical and Electronic Engineers. Plotkin is a Senior Electrical Engineer in the Accelerator Development Branch of High Energy Facilities.

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Published weekly
for the employees of
BROOKHAVEN NATIONAL LABORATORY

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Speakers Bureau

July-December

Jacqueline Mirzadeh (DO), **Janet Tempel** (DO): Commack-Kings Park Rotary Club, Tours at BNL, July 17.

Lewis Jacobson (PE): Port Jefferson Rotary Club, Turn the Heat Down on Your Home Energy Bills, September 17.

William Marcuse (DO): Hartman Systems, Technology Transfer, October 18.

William McGahern (HEF): Half Hollow Hills High School Career Day, Careers in Science, Math and Engineering, October 24.

Frank DeVito (AM): Sachem High School Career Day, Careers in Computers, October 30.

Meyer Steinberg (DAS): New York State Professional Investors Association, Research and Development on Materials and Processes Related to National Needs, October 31.

Betty Heldman (MED.): **Ellen Weidner** (S&EP), St. Patrick's School in Smithtown, Careers for Women in Science, November 7.

Gus Prince (DNE): Brooklyn Technical High School, Scientific Application of Computers at BNL, November 14.

William Marcuse (DO): Smithtown Rotary Club, Technology Transfer, November 14.

Mary White (Pers.): BOCES in Riverhead Advisory Committee, Business Techniques and Management, November 27.

R. Christian Anderson (DO): Fordham University Physics Students, Energy Options for the Future, November 27.

Susan Foster (Pers.): BOCES Adult Education, Employee Relations, December 4.

Susan Eng (AM), **Sharon Spark** (AM): Shoreham-Wading River High School Career Day, Careers in Computers at BNL, December 4.

Martin Plotkin (HEF): Science-Technology-Industry Career Day at Lawrence High School, Careers in Science, December 5.

Cafeteria Menu

Week Ending December 21

Monday, December 17

Cream of broccoli soup	(cup)	.65
	(bowl)	.85
Veal patty scallopine & 1 veg.		2.20
Chicken fingers & French fries		2.10
Hot Deli: Top round of beef	(bread)	2.10
	(roll)	2.30

Tuesday, December 18

French onion soup w/croutons	(cup)	.65
	(bowl)	.85
Breaded pork chop w/applesauce & 1 veg.		2.15
Spaghetti and meatballs		2.20
Hot Deli: Pastrami	(bread)	2.00
	(roll)	2.20

Wednesday, December 19

Holiday Special

Steamship round of beef choice of broccoli spears or glazed baby carrots and choice of baked potato w/sour cream or rice pilau 2.85

Thursday, December 20

Vegetable beef soup	(cup)	.65
	(bowl)	.85
Baked meatloaf & 1 veg.		2.10
Turbot Florentine & 1 veg.		2.10
Hot Deli: Philadelphia steak w/pepper & onions	(bread)	2.10
	(roll)	2.30

Friday, December 21

Manhattan clam chowder	(cup)	.65
	(bowl)	.85
Old fashioned beef stew on egg noodles		2.20
Tuna noodle casserole & 1 veg.		2.10
Hot Deli: Barbecued fresh ham	(bread)	2.00
	(roll)	2.20

PC Users Meeting

The PC/Workstations Group will meet on Tuesday, December 18, at 10:30 a.m. in Applied Mathematics Department Seminar Room. Larry Turf will talk on "Micro-Computer PERT/CPM Software Packages." The two acronyms stand for Project Evaluation and Review Techniques and Critical Path Method, two tools for managing large and small engineering projects.

Notice

Due to the scheduling of a Christmas party on Monday, December 17, at the Rec Hall, the English class will not meet that evening.

—BERA News—

Volleyball

Standings

	W-L
C League	
Screwballs	13-2
Tigers	12-3
Captain Midnight	6-9
Quarks	5-7
Craw	5-7
Couples	4-11
Open League	
Phoenix	15-0
Odds and Sods	9-6
Half Lifes	7-8
Rowdy Radicals	6-9
Team 6	6-9
Generic	2-13

Bowling

Purple League

Joe Ferrante rolled a 247/632 scratch series, Mary Eggert 180/177, Marge Stoeckel 173, Karen Natoli 173, Sharon Moore 172.

White League

High games were bowled by Ed Sperry IV 221, Jim Griffin 208, Kurt Jellett 206, Ken Asselta 204, John Connolly 203, Al Pinelli 202, Jeannette Thiede 211, Sharon Smith 200, Lee Barberich 199/180, Irene Sperry 180.

Red/Green League

J. Muller rolled a 243, R. Larsen 235/210/637 scratch, E. Sperry IV 225/211/614 scratch, G. Meinken 225/201/615 scratch, B. Cahill 224, E. Sperry III 216/207, J. Connolly 212, B. Medaris 205, N. Combatti 205, B. Jones 204, J. Morris 203, N. Parrinello 202, H. Arnesen 201, K. Rier 201.

Runners Corner

This fall, BNL took first place in many races such as Peter Boni's 40:20 win of the Long Island McArthur Airport 7.5 miles, Don McKenzie's 30:22 win of the Mineola 5 miles, and Trever Sears 25:28 win of the Shoreham 5 miles. In these races, trophies were also taken home by Ed Gallagher, Gus Prince, and Joe Bauernfeind.

New on the scene for BNL are Diane Hatton and Sharon Zuhoski taking seven trophies home. BNL road runners were also visible at the New York City Marathon, with Frank Marotta 3:53, Jeanne Penoyar 5:09, and the great performance of Peter Boni with his 3:03. The Philadelphia marathon saw Skip Medeiros turn a 3:13 and Wen-Shi Yu a 3:18. Gus Prince returned to marathoning with a 3:25 and will be at Boston next year. The Atlantic City Marathon was conquered by Joe Bauernfeind with a 3:28 PR and only a nominal loss at the Black Jack table.

The road runners are planning some new activities for 1985, which will include a membership drive, club running outfits with logos and a new race course. All to be discussed at the January meeting.

Peter Horton

If you haven't finished your holiday shopping, Janet Tempel (right), Ellin Kelsch and friend are dying to sell you something from the Science Shop. Sale days are December 19 - 21, Wednesday, Thursday and Friday, from 10 a.m. to 3 p.m. each day. You will find an assortment of items ranging in price from 10¢ to $7.75. A number of them are science-related, like suitcase science kits and bug boxes, and many are just for fun, like star wands and rocket erasers. The store carries over 60 different items. New this year are Top Secret tops (buy one and find out), USA stick-on maps, astro maps, and Bet You Can and Bet You Can't books full of science tricks to try out. The Science Shop is located on the west side of Bldg. 701, which houses the Exhibit Center. Since the store is normally open only during tours, don't miss this sale next week. It will be a good chance to get some stocking stuffers or small Hanukkah gifts.

Arrivals & Departures

Arrivals

Mingyan E. Chen ..... Physics
Larry Jones ..... Plant Eng.
Walter E. Mars ..... AGS
Keith L. Monson ..... Biology
Swapna Mukherji ..... Plant Eng.

Departures

This list includes all employees who have terminated from the Laboratory, including retirees:

John J. De Michele ..... Medical

Micom

The next meeting of the MICOM Users' Group will be on Wednesday, 19 December, at 3 p.m. for all users in the Conference Room 2-160 of Bldg. 510A (Physics). Ruth Stannish and Eileen Riehl (MICOM representatives) will be present and will discuss vocabulary.

GIVE LIFE

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If you'd like to give a gift to humankind this holiday season, how about giving life, in the form of a pint of blood? An opportunity to do just that is coming with BNL's Winter Blood Program, on Tuesday and Wednesday, December 18 & 19, from 10 a.m. to 3 p.m. To schedule your donation, call program coordinator Elaine Zukowski, Ext. 3334. When you arrive at the gymnasium to fulfill your pledge, you will automatically become eligible to be in a drawing for one of five $60 gift certificates for dinner at the Old Inlet Inn in Bellport.

Classified Advertisements

Placement Notices

The Laboratory's placement policy is to select the best-qualified candidate for an available position, with consideration given to candidates in the following order of priority: (1) present employees within the department, with preference to those within the immediate work group; (2) present employees within the Laboratory as a whole; and (3) outside applicants. In keeping with the Affirmative Action plan, selection decisions are made without regard to age, race, color, religion, national origin, sex, handicap or veteran status.

Each week, the Personnel Office lists new personnel placement requisitions. The purpose of these listings is, first, to provide open placement information on all non-scientific staff positions; second, to give employees an opportunity to request consideration for themselves through Personnel; and, finally, for general recruiting purposes. Because of the priority preference policy stated above, each listing does not necessarily represent an opportunity for all candidates. As a guide to readers, the listings are grouped according to the anticipated area of recruitment.

Except when operational needs require otherwise, positions will remain open for one week following publication date.

For further information regarding a placement listing, contact the Employment Manager, Ext. 2882.

LABORATORY RECRUITMENT - Opportunities for Laboratory employees.

2152. SECRETARIAL POSITION - Requires AAS degree in secretarial science or equivalent, a high level of competence in secretarial skills, and an extensive knowledge of Laboratory procedures and policies. Will be responsible for report production on a word processor and the establishment and maintenance of file and record systems for the Energy Economics Systems Analysis Division, Department of Applied Science.

2153. SECRETARIAL POSITION - Requires AAS degree in secretarial science or equivalent and a broad knowledge of Laboratory operations, procedures and policies. Must have a high level of competence in secretarial, organizational and communication skills. Ability to take shorthand desirable. Will perform secretarial and office management functions in Department Administrative Office, Physics Department.

2154. TECHNICAL POSITION - Requires AAS degree in a technical field or equivalent experience. Will be responsible for the collection of environmental samples in and around the BNL site, field measurements, routine maintenance of sampling equipment and preliminary analytical processing of the samples for pollutant assay. Safety and Environmental Protection Division.

OPEN RECRUITMENT - Opportunities for Laboratory employees and outside applicants.

2155. FINANCIAL/PROGRAMMING ANALYST - (one year appointment). Requires master's degree with a concentration in financial analysis. Excellent FORTRAN programming and oral and written communication skills are essential. Several years' experience in financial analysis and knowledge of the electric utility or gas industry is highly desirable. Department of Applied Science.

2156. PROGRAMMER ANALYST - (one year appointment). Requires BS or MS in applied math, engineering or another quantitative discipline, excellent oral and written communication skills and proficiency in FORTRAN. Knowledge of IBM and CDC JCL is desirable. Department of Applied Science.

2157. ECONOMIST - (one year appointment). Requires a PhD in mathematical economics, econometrics or related field and experience in FORTRAN programming. Background in regulatory economics is desirable. Responsibilities will include econometric studies as it relates to natural gas markets, electric utilities and commercial sector energy demands. Background in regulatory economics is desirable. Department of Applied Science.

2158. PROJECT ENGINEER - Requires BS or MS in electrical engineering or equivalent and five to ten years' experience. Background in digital circuitry, computer control systems, network analysis and general electronics necessary. Will be involved in the design and construction of irradiation facility and related hardware and systems. Department of Nuclear Energy.

2159. ASSOCIATE STAFF ENGINEER - Requires BS or MS in electrical engineering or equivalent and one to two years' experience. Some background in analog/digital systems necessary. A good foundation in electromagnetism theory required. Will be involved in the design and construction of irradiation facility and related hardware. Department of Nuclear Energy.

2160. DESIGN POSITION - Requires BS in mechanical engineering or equivalent and five to ten years' experience in machine design and machine shop practices. Experience in vacuum technology and electromechanical devices desirable. Will be involved in the design of irradiation facility and related hardware and systems. Department of Nuclear Energy.

2161. P & GA SPECIALIST C - Requires darkroom experience including slide mounting, photographic processing, reproduction and maintenance. Will be expected to work from written or oral directions to execute black and white or color photographic reproductions. May also perform general clerical duties such as filing, typing and the taking of job orders as required. Photography and Graphic Arts Division.

Autos & Auto Supplies

72 CHEVY NOVA - 307 V8, 2 dr., a/t, p/s, $500. Jeb, Ext. 4331 or 286-0204.

SNOW TIRES - 600 x 12, $15/pair; Dodge pick-up bed, step side, 4'x8'. Ken, Ext. 4514 or 289-8212.

TRUCK TIRES - (4), 16.5 in., mounted on 8-lug rims, $325. Walter, Ext. 4028.

64 VW BEETLE - fair cond., 4 spd., good buy at $200. 475-1095.

81 VW - 4 dr., diesel, 4 spd., 53,000 mi., $3,500. Ext. 2051 or 734-7366.

78 CHEVY NOVA - 6 cyl., 2 dr., low mi., very good cond., p/s, p/b, a/c, orig. owner, $2,950. 271-5952.

74 CHEVY VEGA - 4 cyl., auto., runs great, alum. rims, asking $900 or best offer. 70 Ford Falcon, straight/6 cyl. engine, runs great, $300 or best offer. 878-0939 after 6 p.m.

78 OLDS - Custom Cruiser wagon, new gas engine, excel. body, $2,900. Ext. 7742 or 3212 after 6 p.m.

RIM - Ford/Mercury, 14", 5 hole, $5. Tony, Ext. 3637.

71 CHEVY IMPALA - a/c, p/s, p/b, V8, good cond., 82,000 mi., $900. Ext. 2673 or 744-8632 after 6 p.m.

78 CHEVETTE - 4 dr., auto., 59K mi., $1,300. 286-1396 eves.

TIRES - 175R14 radial, Michelin, $15; 6.95-14 polyster, Goodyear, $10; G78-14 snow, Sears, $10. Jan, Ext. 4263.

75 PLYMOUTH DUSTER - good body, runs excel., 3 spd., am/fm cassette, chrome slots, $850. 289-0570 after 6 p.m.

80 KAWASAKI - KX80, excel. cond., $425. 325-1754 eves.

81 TRAILER - Viking pop-up camper, 18', sleeps 6, stove, sink, ice box, heater, awning, great cond., $2,000 firm. 744-9677.

77 BMW - 320 i, auto., am/fm cassette, for lights, sunroof, $5,500. Ext. 2888 or 286-0422.

73 DART - slant 6, auto., a/c, new brakes, tires, rebuilt alternator, water pump, radiator, $675. Joe, Ext. 2697.

TIRES - (2) P195/75R14 (same as ER78x14), $10 ea. Morris, Ext. 4192.

78 MERCEDES BENZ - 300 diesel, clean, very good cond., asking $10,500. Ext. 7959 or 727-5803.

RIMS - G78-14, $5 ea.; chains, 7.10-15, 8.00-14, new, $20/pr. Ruppert, Ext. 3254.

83 RENAULT/AMC - 4 drs., 26,000 mi., asking $6,500. Lou, Ext. 4666.

80 TOYOTA COROLLA - 1.8 liter, 2 dr., 5 spd., sedan, $3,500. Carl, 744-2069.

80 AUDI 5000 S - diesel, 5 spd., 38 mpg., all pwr., air, cruise control, am/fm tape, met./red, low miles, $7,900. 941-4999.

SNOW TIRES - (2) fiberglass, belted, mounted on Ford rims, G78-15, $25. Ext. 2423.

70 DODGE WINDOW VAN - 318, auto., long wheelbase, heavy duty hitch, new tranny, $750. Ray, Ext. 3536 or 289-7615.

71 AUDI - 100 LS, runs well but needs work, $250; 1963 Mercury Comet, good tires, eng., a/t, use for parts, $200. John, Ext. 4214 or 475-5543.

75 PACER - 6 cyl., auto., p/s, p/b, am/fm, new exhaust, good tires and battery, asking, $675. Ext. 3569 or 286-9560 after 6 p.m.

SNOW TIRES - Sears roadhandlers, steel belted, w/w, 185 x 15", $30/pr., Ext. 2705 or 286-1062.

81 VW RABBIT LS - excel. cond., am/fm stereo, a/c, 50,000 mi., asking, $3,700. 751-5554.

73 FORD - "The Blue Bomb," runs well, at least it did yesterday, $195. Mike, Ext. 7941.

81 PLYMOUTH - TC-3, 4 spd., am/fm, p/s, mint cond., 4 cyl., maroon/matching interior, $4,000. Aug, Ext. 2898 or 363-7620.

82 MAZDA PICK UP - long bed, T-covers, rust proofed, 28,000 miles, mint cond., $4,500. 751-8240 eves.

VESPA BRAVO MOPED - Super Deluxe, Class B, excel. cond., used very little, $450. Lloyd, Ext. 3381 or 286-1024.

80 FORD FAIRMONT - 6 cyl., 4 dr., great body, runs well. 929-4734

72 MUSTANG - p/b, p/s, a/c, radio, auto., 302 engine, 63,000 mi. 589-4872.

77 CHEVETTE - 4 spd., 71 Kmi, runs well, good mpg, $1,200. Ext. 4457.

YAMAHA CYCLES - (2) 78-IT-175 and 74-TY-250, good for parts. 286-1855.

79 CHEVY MONZA - V6, 4 spd., p/s, p/b, air, am/fm, stereo, new rubber. good mpg, $2,800. 878-0012.

70 CHEVY IMPALA - 4 dr., 8 cyl., good tires. 929-4734.

TR7 - 4 spd., fm stereo, white w/black vinyl roof, clean inside and out. Dottie, 698-2229.

72 DODGE DART - 6 cyl., $500 neg. 929-6531.

TIRES - (2) Pirelli-P3, 175SR14, low mileage, $75/pr. Ext. 2253.

79 TOYOTA LANDCRUISER - excel. cond., in and out, 4 wheel drive, big tires, $5,500. Bill, 281-6022.

STATE INSP. EQUIPMENT - scuff gauge for alignment, ball joint checker, etc., excel. cond., $75. Dan, Ext. 4987 or 698-7322.

Boats & Marine Supplies

OUTBOARD MOTOR - Evinrude, 85 Hp, elec. shift, elec. start, runs OK, $350. John, Ext. 5152 or 281-2471.

14' ALUM. BOAT - used a lot, but dry, $125. Ext. 3992 or 298-4172 after 6 p.m.

73 CUDDY CABIN - 115 Merc., trailer and extras, $1,800. Dottie, 698-2229.

O'DAY 20' - 6 HP, galvanized trailer, head, galley, 4 berths, bow pulpit, life liner, $6,800. Bill, Ext. 2906.

Miscellaneous

SWAGLAMP - 16", brown wicker shade, $30; brass headboard for double bed; Zenith B&W TV, $25. 744-6874.

MOVING SALE - for items & prices. 732-5004.

BOY'S SNOW BOOTS - size 8, $6; boy's football shoulder pads, $12. Maurice, Ext. 2487 or 928-6930.

CONVECTION TURBO OVEN - Farberware, $50. Yako, Ext. 2592 or 3349.

CAMERAS - Voigtlander 35mm w/portrait, 50mm & 135mm lenses, filters & cases, $125; Kodak Instamatic 40 w/case, electronic flash, $20. Ext. 2981.

REMO DRUM PAD - w/stand, drum sticks & books for beginner, like new, all for $35. Ext. 3604 or 878-0516.

HEAVY WORKBENCH - storage underneath, $20; large, sturdy, wooden storage cabinet, $25; old wooden d/r table, $40; bookcase, $15; china closet, $100. 878-6637.

MODEM - for IBM-PC, Inboard mount, 300 b., software included, asking, $100. Marwin, Ext. 4967 or Ext. 4027.

CHRISTMAS COOKIES - fruitcakes, breads. Adriene, 286-8424.

TRESTLE TABLE - 3'x5' Colonial, w/2 leaves, $25. Ext. 3859 or 286-1712.

TREES - locally grown, evergreens, maples, dogwood, you dig, reasonable. 924-6582.

WINDOWS - (4) 44x38, (1) 76x56 w/storms; gas stove, good cond. Ext. 7976 or 261-7280 after 6 p.m.

GAME CARTRIDGES - Coleco or Atari, reasonable; boy's 20" BMX type dirt bike. Ext. 2888.

COAT - Persian lamb, full length, mink collar & cuffs, size 18, immaculate, $150. 732-5004.

CABBAGE PATCH KID - girl, orange hair, green eyes. Sheree, Ext. 2907 or 727-3698.

COMPUTER - Atari 800, 48K, Rana 1000 disk drive, cassette recorder, BASIC cartridge, many games, less than half retail, $350. 473-2473.

TRESTLE TABLE - 5-1/2', bench, chairs, $145. 286-0795.

SKI BOOTS - Nordica, never used, size 13M, $50. Ext. 4018.

CHRISTMAS TREE - 6', artificial, perfect, $10; exterior Christmas lights, large bulbs & reflectors, $2/strand. Sue, Ext. 3675.

COLOR TV - Sylvania, 17", portable, very sharp picture, $90. Ext. 4153 or 732-5829.

CAMERA - 35mm Minolta SLR., Model X570, 3 mo. old, used very little, asking $150. 588-5315 eves.

OIL BURNER - used w/new transformer, excel cond., $25; (2) car seats; (2) baby cribs, 1 w/new mattress. 821-1525.

COLECO VISION - orig. box, 3 game cart., like new, $70; Fischer 160 skis, w/Tyrolia binding, poles, man's Raichle boots, size 12, excel., $125. Ext. 3604 or 878-0516.

MAGNAVOX STEREO - hi-fi console, good cond., $125; Wurlitzer organ, spinet, solid cherry, model 4300D, excel. cond., $750. Lloyd, Ext. 3381 or 386-1024.

SCARVES - 100% silk, original design, hand painted, washable, $20/ea. 472-1596.

UNICEF XMAS CARDS & GIFTS - for info./order. Anh, Ext. 2022 lunch time or 744-8386 eves.

SKI RACK - for VW bug, locking, $15; white ceiling paint, sand texture, 3 gallons, unopened, $15. Bill, Ext. 2906.

DISHWASHER - Lady Kenmore, portable, convertible, butcher block top, very good cond. Peter, Ext. 2304 or 744-1334.

EXECUTIVE DESK TOP - 3 ft. 8 in. x 5 ft. 6 in., 8 drawers, no chair, $100 (cost $1,000). J. Soler, 475-4596.

SKIIS - AMF Head Vector, Large ski boots, 10 1/2, Rossignol, ski poles, $150. Ext. 2423.

BABY CRIB - $40; baby carriage, $20; baby car seat, $5. 399-4394.

MOBILE CB - 40 channel radio, antenna and SWR meter, $40; Kodak pocket instamatic 30 camera w/flash, $10. Ext. 4680 or 286-1331 after 5:30 p.m.

OAK DESK - 34"x60"; steel desk 30"x55" w/rolling chair: shop vac. Paul, Ext. 4156.

BASKETBALL RIM - $5; girl's ice skates, 6 pr., sizes 4-13, $2/pr. Ext. 4846.

COMMADORE VIC 20 - brand new, still in box, $55 firm; marble coffee table, round, wood trim, mediterranean, 36" excel. cond., $50. 751-4822.

CAMERA - Olympus, 35-year gift, make offer. Andy, Ext. 2907.

ORGAN - portable, Casiotone mt 40, like new, in box, cost $172, sell for $90 firm. 924-8634.

RADIO EQUIPMENT - 65-ft. tower, rotor, antennas: TA33 beam, 2m beam, 80/40 m dipole, $300; alum ladder, 24 ft., $75. 732-5004.

SONY WALKMAN - fm stereo, model SRF-30W, w/MDR-1 headphones, batteries, $20. Ext. 7192 or 924-0813.

BEDROOM SET - triple dresser, high chest, night stand, mirror, two twin bed headboards, excel. cond., $400. Ext. 3293 or 698-6437 eves.

CRIB - Simmons w/mattress, excel. cond., $150. Mike, Ext. 7941.

ELECTRIC GUITAR - Global, beginner, Gibson strings, two pickups, w/case, $75. Ext. 2380.

FURNITURE - colonial antique pine hutch, rush chairs, trestle table, deacon's bench, drum table, spindle mag. rack, spoon rack. 286-1205.

SKI PANTS - man's wool, polystretch, dark blue, 34R, never worn, $75. Ext. 4727.

SHELLS - coral, shell craft, with wind chimes, coin desk sets, for Xmas gifts. Whitey, Ext. 2913.

SPEAKERS - 2-way acoustic suspension w/2" tweeter, 8" woofer, 22½" H x 12½" W x 8¼" D, $50/pr. Ext. 7192 or 924-0813.

HOT WATER HEATER - 40 gal. capacity, natural gas, 15+ years old, $25. Nick, Ext. 2490.

LENS - Vivitar Series 1, 70-210mm for Minolta SLR, macro focussing, auto. 200m w/Tiffen filter, $120. Ext. 4725.

CAMERA - Minolta XGI, 35mm, new carry-all bag and auto. electronic flash, $150. Ext. 2456.

XMAS LIGHTS - indoor and outdoor, like new, reasonable. Nancy, Ext. 5274 or 281-2767 eves.

TRIPOD - for 35mm camera $15. Ext. 3319 or 751-7140.

CHRISTMAS TREES - blue-green spruce, 4-14 ft., cut-while-you-wait or cut-your own, Brookhaven Hamlet. Ext. 4040, 289-0876 or 286-0024.

10 SPD BIKE - 21" in. frame, mfg. Kia, yellow, very good cond., $40. B. Sanchez, Ext. 3848 or 281-6498.

FISH TANK - stand, power filter, hood light, complete, $25; range hood, 36", copper, $15. Aug, Ext. 2898 or 363-7620.

FUR STOLE - good cond., $40; citrus juicer, almost new, $15. Ext. 3701 or 751-8128 eves.

SECTIONAL - 2 pieces, convertible love seats, colonial chair, will deliver. 929-8287.

COLOR TV - 19" Spectricon, $200; golf clubs, 3 woods, 8 iron, $120. Leaving tommorrow must sell. Ext. 2364 or 3216 after 6 p.m.

FIREWOOD - 744-3792.

WOOD WINDOW - double hung, approx. 3½' x 4½', new, excel. cond., $50. Joe, Ext. 5233 or 369-0432.

ACCORDIAN - 120 base, $100. Ann, 286-2280.

DINING TABLE - 52(78) x 48, oval, excel., $60. Ext. 2830.

MAN'S BIKE - 12 spd., new, in original carton, $100. 472-1243 after 6 p.m.

SKI RACK - locking, good cond., $20. Ext. 4449 or 751-8403 after 6 p.m.

BOY'S HOCKEY SKATES - size 5, never worn; toys & games, exc. cond.; wooden Xmas tree ornaments; space heater; humidifier. S. Spark, Ext. 4111.

CABBAGE PATCH PREEMIE - $55. Henry, Ext. 4547 or 924-6688.

CAMERAS - Voigtlander, 35mm w/portrait, 50 mm and 135 mm lenses, filters, cases, $125; Kodak Instamatic 40 w/case, electronic flash, $20. Ext. 2981.

KITCHEN SINK - stainless steel, excel. cond., $35; quarry tiles, new, brown, 6" x 6" x 1/2", 22 sq. ft., $20. Tom, Ext. 4084 or 878-1060.

Free

HOLIDAY ENTERTAINMENT - 8 p.m. tonight, Berkner Hall, Theater Group-sponsored program of readings, music, Lucia festival.

Car Pools

NORTHPORT/FT. SALONGA - 3-person, on-time carpool looking for 4th member, door to door. Brian, Ext. 2799.

ELWOOD/E. NORTHPORT - 4-driver pool looking for 5th driver. Paul, Ext. 4156.

MATTITUCK - driver needed to fill 4-man car pool. J. Haeg, Ext. 4863 or 298-4117.

Real Estate

Real Estate advertised for sale or rent is available without regard for the race, color, creed or national origin of the applicant.

For Rent

ROCKY POINT - 3 bdrm. ranch, immaculate, fenced, new carpets, dishwasher, $700 & util. Sue, Ext. 3675 or 473-6570.

BELLPORT VILLAGE SOUTH - near bay, stores, fully furnished, spacious modern house, all appliances and piano, mid. Jan.-mid. July, adults only, rent negotiable to responsible tenant. 286-0379.

SELDEN - studio apt., pvt. ent., eik, working adult, $430 includes all. 698-8514 after 5 p.m.

STONY BROOK VILLAGE - water view, 1 bdrm. apt., furnished or unfurnished, $600, utilities inc. 751-8210 eves.

CENTER MORICHES - centrally located, large eik, 2 bdrm., living room, bath, washer and dryer, separate heat, elect., and entrance, nice quiet, rear yard, $525/mo., security required. 878-2461.

WADING RIVER - beautiful apt., 10 min. to BNL, private entrance/parking, excel. for single or couple, adults only, $550/mo., which incudes util. 727-8130 or 369-2705.

BELLPORT VILLAGE - studio apt., 100 yds., from water, yr. round, starting Jan. 1, unfurn., utili incl., $400/mo. Ext. 3128 or 286-8925.

SETAUKET - farm ranch, walk to SUNY, 1 acre, next to golf course, $750/mo. plus utilities, no pets. 751-8240.

MIDDLE ISLAND - beautiful, 1 large bdrm. apt., in Artist Lake, heat incl., club facilities, Ext. 4743 or 924-8481 eves.

CORAM - small studio apartment, all utilities, very reasonable, secluded, close to Lab. 732-3681 or 878-8294.

E. PATCHOGUE - S. of S. Country Rd., 2 bdrm. apt., l/r, eik, priv. ent., avail. Jan. 1st, no pets. $400/mo. + util. Walt, Ext. 2907 or 698-0576.

E. PATCHOGUE - 2 bdrm., furn., next to Bellport Golf course, view of Great South Bay, across from beach, until June. $550/mo. 289-9724.

For Sale

MILLER PLACE - 4 bdrm. Colonial, formal l/r, d/r, country kitchen, 4 baths, family room w/brick wall fireplace. 331-1718.

STONY BROOK "S" SECTION - Devon Ranch, 3 bdrms., 2 baths, f/p den, w/w, 1-1/2 garage, 4 acre, taxes $2,500, asking $132,000. 751-0861 after 6 p.m.

Wanted

PERSON - who knows someone to repair old Victrola wind-up spring. 878-6637.

ROOMMATE - to share kosher home in Port Jeff. station, no pets. Marwin, Ext. 4967 or 4027.

TAP SHOES - for child, size 1-2. 298-4398.

DRESSING TABLE - 286-1662.

ICE SKATES - size 14 1/2. Walther, Ext. 4309.

ELECTRIC HOT WATER HEATER - free, doesn't have to work, will pick up. Ernie, Ext. 2957.

DODGE DART - 1965-69, for parts, need radiator, grille, l.f. fender, bumper, not running o.k. Bill Sanchez, Ext. 3848 or 281-6498.

FULL SIZE VIOLIN - in good cond. Steve, 744-4787 eves.

DOLLHOUSE - empty, wooden. Liz, Ext. 2430 or 286-8563.

TIRES - (2), 15", to fit Volvo 142, preferably snows. Aug, Ext. 2898 or 363-7620.

HOUSEMATE - to share large house, 8 min. from Lab., 10-acre, $200/mo. + 1/4 util. Roland, Ext. 3969 or 924-3669.

ROLLER SKATES - women's 7 1/2 or 8, boy's size 2, also student's wooden desk. Ext. 4771 or 286-8747.

TOYS - new or used for needy children, project of YPD of Missionaries of L.I. area, A.M.E. churches, for further info. call Debbie, Ext. 3420.

In Appreciation

THANKS - to everyone in Fiscal for all the get well cards and plant. Dottie Tapp

Classified Ad Policy Deadline is 4:30 p.m. Friday for publication Friday of the next week.