BROOKHAVEN BULLETIN
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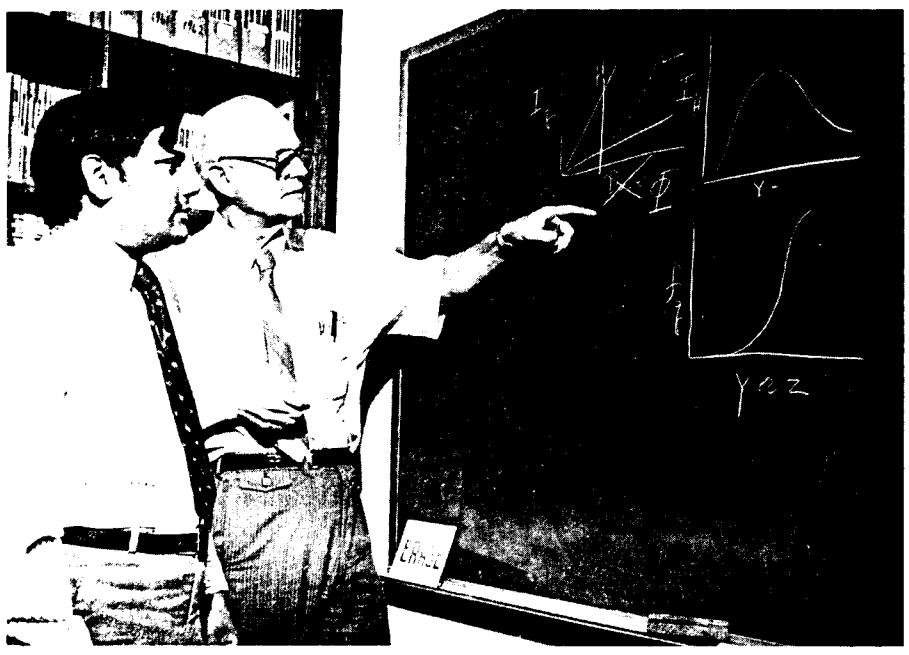
BROOKHAVEN NATIONAL LABORATORY

New Method for Evaluating Low-Level Radiation Exposure



Peter Horton

Matesh Varma (left) and Victor Bond

Victor Bond and Matesh Varma are proposing a new method of evaluating low-level radiation exposure (see story). Their research, described in the figures below, would permit scientists to measure radiation thresholds for individual cells.

Radiation damage to an organism starts with injury within a single living cell. Cells can sustain hits up to a certain size from radiation particles, without being permanently harmed. Beyond that threshold, the amount of radiation deposited in a cell is great enough to cause irreversible damage that may lead to genetic change or death of the cell. Early effects of radiation damage include tissue, organ or organism dysfunction or failure, and are due to the killing of a large number of cells. Long-term effects such as cancer or heritable damage may result from damage to only one cell.

Until now scientists have been unable to express radiation thresholds below which harmful, long-term radiation effects do not occur. Associate Director for Life Sciences Victor Bond and Matesh Varma, who divides his time between the Safety & Environmental Protection Division and the Physical & Technological Research Division of DOE's Office of Health & Environmental Research in Washington, are proposing a new method of evaluating low-level radiation exposure which will permit scientists to measure radiation thresholds for cells.

That method, as described in the accompanying figures, is based on a new concept Bond and Varma call "hit-size effectiveness function" (HSEF). HSEF is simply the probability that the energy deposited in a cell through an interaction with radiation (hit-size) will cause a change in the cell that is not spontaneously reversible. Such a "quantal response" may lead to distinctly observable consequences, like those which have already been seen in the plant *Tradescantia*.

Using previously published data on pink mutations in *Tradescantia* for seven different types of radiation, and using distributions obtained from a proportional counter, Bond and Varma have evaluated the HSEF. "Normally the *Tradescantia* cells are blue, but when they are exposed to radiation, they turn pink," explains Varma. "Our analysis indicates that a threshold for pink mutations occurs around two thousand electron volts deposited per cell, and that 100% probability of inducing pink mutations occurs around 400 thousand electron volts."

Bond and Varma have preliminary results which show that HSEF is similar for cell killing in mammalian cells, and they intend to evaluate this function for chromosome abnormalities in human lymphocytes. "We are conducting these studies to see if HSEF holds for different biological systems and different responses to radiation exposure," says Varma.

"If the universality of HSEF is established, then this approach will be conceptually more correct than the 'dose'-response curves now used in radiobiology. The new approach would obviate the need for a "standard" radiation, relative biological effectiveness, quality factors, REM, and dose equivalent in radiation protection," explains Bond.

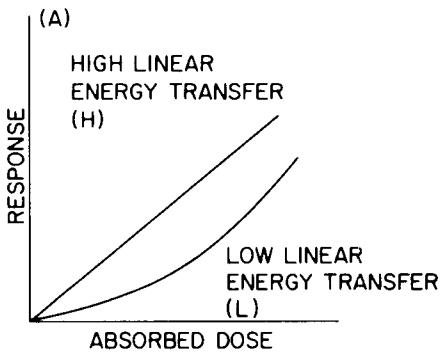
"The HSEF curve gives risk coefficients directly," he continues. "Thus, this approach is applicable in any mixed radiation field. This research would lead to the development of realistic and scientifically sound risk estimates for diseases caused by low-level radiation."

— Marsha Belford

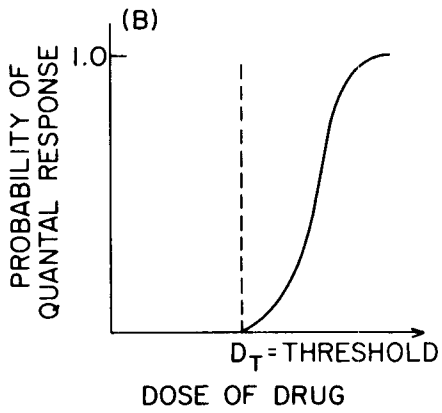
The dose-response curves currently used in radiobiology are supposed to represent the response of cells as a function of absorbed dose, the average energy deposited per unit mass of irradiated material (Figure A). Bond and Varma have shown that the dose absorbed by organs is a conceptually incorrect and misleading quantity for use with low dose and low-dose rates of radiation exposure.

"Scientists have been trying to find a threshold using the concept of absorbed dose at low doses, but they cannot now find it because the curve they are working with is not a true dose-response curve," says Varma. "Instead, it is an exposure-response curve, and these curves do not have thresholds.

"For low-level radiation dose, the number of cells per unit mass that actually interact with radiation is much smaller than the number of cells exposed," explains Varma. "To distribute the energy deposited in a few cells to other cells which have not interacted or to the entire organ, as is done using absorbed dose, is wrong."



"Since the interaction of radiation with any given cell and the amount of energy transferred are random in nature, there is always a finite probability that the cell that is hit will have received enough energy to produce the response," continues Varma. "Thus, if we want to understand dose-response curves correctly and find a threshold, we must find a dose-reponse curve for cells at low-level exposure which is conceptually analogous to the dose-response curves used in pharmacology, toxicology and medicine which have a threshold for organ failure after exposure to drugs or other chemicals." (Figure B.)

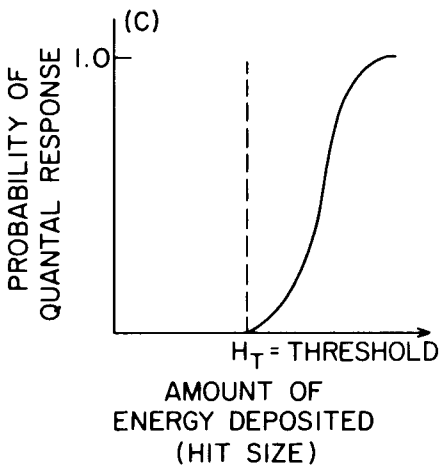


"In the region where malignant and genetic responses are due to single cells being hit with radiation and transformed, individual cells, not organs, are what show threshold effects," says Bond. "Therefore, we were looking for a way to express the 'dose' of radiation absorbed by the cells."

Bond and Varma are proposing that cell response depends upon "hit size," the amount of energy deposited in the cell through an interaction with radiation. If the hit size is below a threshold value, then the cell may sustain some injury, but the cell repairs itself.

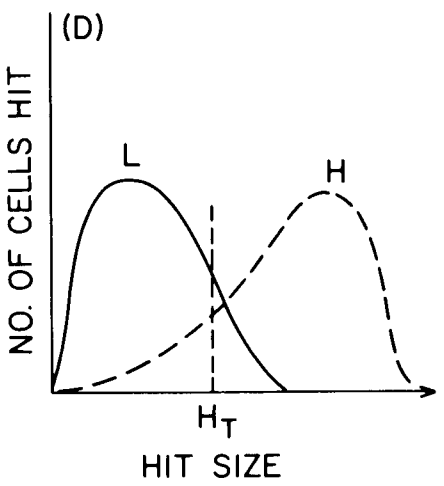
However, if the hit size is equal to or greater than this threshold, then the hit size is large enough to cause a "quantal response," a change in the cell that is not spontaneously reversible and may lead to clinically observable consequences. The probability of showing the quantal effect increases as the hit size increases, until the probability of causing the response is 100% at a sufficiently high hit-size value (Figure C).

Bond and Varma term the probability of a quantal response as a function of hit size a "hit-size effectiveness function" (HSEF). They claim that this function for cells is conceptually identical to the pharmacological dose-response function for organs (Figure B).

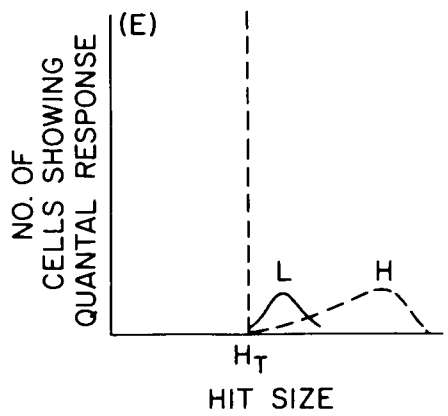


"If, in a given biological system, one could identify the number of cells hit, the hit size in each individual cell, and the number of cells showing a quantal response, then you could easily obtain the hit-size effectiveness function," says Varma. "But it is impossible to observe the number of cells hit and the amount of energy deposited in each cell. The only biologically observable quantity is the number of cells which show the quantal response."

To estimate the amount of energy deposited in each cell, Varma and Bond used a proportional counter filled with tissue-equivalent gas to simulate a cell nucleus. When the proportional counter is placed in a radiation field, it electronically determines the number of cells hit and their distribution as a function of hit size for low-level radiation exposure (Figure D).



This distribution is multiplied by an HSEF. The resulting curve is then integrated over all hit sizes to calculate the number of cells that show a quantal response (Figure E).



Patents Awarded

Chyng-Yann Shiue and **Alfred P. Wolf**, Chemistry Department, were issued U.S. Patent #4,439,414 for developing a new method of preparing and isolating novel radiopharmaceuticals such as 1- and 2-^{11}C-D-glucose, mannose and galactose. These compounds can be used as diagnostic agents in nuclear medicine, specifically for mapping the course of glucose metabolism, for example, in the brain and heart, and for following galactose metabolism in the human body. The compounds can be synthesized by a technique utilizing radioisotopes which have a sufficiently long half life to permit the completion of positron emission tomographs without unnecessarily producing a high radiation burden for the patient.

•

Chyng-Yann Shiue and Alfred P. Wolf were collaborators on another patent, #4,436,717, which was issued for their development of a novel radioactive compound. ^{18}F-labeled 4-fluoroantipyrine has high specific activity, making it suitable for medicine diagnostic applications, specifically, for measuring regional cerebral blood flow. The invention also provides for the synthesis of ^{18}F-4-fluoroantipyrine by direct fluorination.

A Photographer's Photographer

"He's very much a photographer's photographer. I don't think there's a technical problem around that he can't find a solution to." Colleague Doug Humphrey's praise for BNL photographer Mort Rosen is echoed by many in the field.

Rosen's a perfectionist, you see.

Evidence of his expertise came to light at recent national and state expositions of professional photographers, where all of the photos he entered in competition were selected as the best in their categories. His three winners at this year's national convention of the Professional Photographers of America (PPA), held in June, were: a portrait of a ballerina, an underwater photo of the Cerenkov glow at the High Flux Beam Reactor, and a picture of BNL's Radio Frequency Quadropole that appeared on the cover of CERN Courier magazine. At the Professonal Photographers Society of New York convention held in May, the latter two and two other portraits were declared winners.

Winning photographs in several categories, including wedding, industrial, and classified photography, were awarded the distinction of being placed on display during the expositions.

The striking aspect of Rosen's awards is that they are in two unrelated categories — portrait and industrial photography. In the photography world, even the best photographers consider it to be quite an achievement to win in a single category, and his consistent winning over the years in two categories gives him the distinction of specializing in two different areas at once — which is very rare.

Rosen's total number of winning photos over the years have been amassed as merits toward the PPA's honorary Master of Photography degree. The degree is held in high esteem by professional photographers, and he currently needs to attain only a few more merits in order to complete the degree requirements.

Other distinctions that Rosen has achieved in the past include two photos chosen for the PPA's Traveling Loan Collection, which is a selection of the finest photographs from the winning categories that is displayed at different places around the country. At the state level, he has also had four photos win recognition in Courts of Honor, which are special ceremonies acknowledging the best photographs in the state.

BNL photographer Mort Rosen displays his winning photos from recent expositions of professional photographers. For this one, son Ian was behind the camera.

Sitting in his second-floor office in Bldg. 118, Rosen looks like one consumed by his work, as an array of slides, negatives, prints and other photo accessories lies strewn in a sort of random order about the room. He sits comfortably amidst it all, and although he prefers to talk about his work rather than himself, he politely obliges.

"My hobby has always been photography," he says, a reminiscent smile spreading across his face. In fact, it has been Rosen's first love since his boyhood in Queens. He also enjoyed other hobbies such as music and chemistry and has always had an appreciation for art. "Although I had planned on a science-related career," he said, "I realized that photography would provide more room for the artistic expression that I enjoyed, particularly in the field of science, which I knew would eventually be my calling." In his years at the Rochester Institute of Technology and in the Air Force, he gained valuable experience in the field. Before coming to Brookhaven, he worked as an industrial photographer for a Manhattan firm. Finally, at the Laboratory, he was able to realize his ideal work situation: an opportunity to combine science and photography.

His versatility has highlighted Rosen's 26 years at Brookhaven. His work has ranged from doing all the aerials at the Lab to photography in manholes, and everything in between, such as studio portraits for retirees and publicity photos. In such a demanding profession where one never knows what angle will be presented next, Rosen keeps things in perspective. "Some things are very menial but require a great deal of expertise, and some things are very important but can be very routine," he says. "It's almost the kind of situation where you can say 'name it' and really mean it."

He splits his time about evenly between fieldwork and the studio, and has used every piece of photo equipment, "from the studio camera right down to the Nikon." Currently his all-purpose field camera is the Bronica 120, a standard high-quality professional camera. It has features that allow Rosen to work in tight corners, sideways and even upside down.

Rosen's love for his work extends beyond his duties at the Laboratory and entering competitions to the photo studio that he and his wife, Caryn, own near their home in Sayville. She's a capable photographer herself — "she's had formal art training and has a natural flair for business" — and complements Rosen well.

Photography has become such a large part of Rosen's life that he no longer distinguishes between the different types of work that he does. No matter which kind — studio, fieldwork, scientific, anything — he always tries to see his subject from the best angle. "I always look for the artistic value in everything I do," he says, "and even though something may be very mundane, somehow I always try to gild it a little bit to get something pretty or esoteric."

Many of Rosen's photographs have traveled worldwide, appearing inside and on the covers of a wide range of publications, including Physics Today, Photomethods, CERN Courier, Studio Photography, and two cover photos on the PPA Journal, a rare achievement. His latest cover photo is on the June issue of Nuclear News, a portrait of BNL senior physicist Joseph Hendrie, the newly-elected president of the American Nuclear Society. Many other photos have appeared in publications without his knowledge. In fact, he says, it's not uncommon for him to go to his children's school library and find a picture he's taken in their textbooks or encyclopedias. He also recalls one instance when he was browsing through a Japanese scientific publication that had only one picture inside — and it was his.

Instances such as these have been very satisfying to Rosen, but they only partly explain why he continues to do what he does. "It's love of the profession that keeps you at it," he says. Every day, Rosen brings to work this refreshing level of enthusiasm and professionalism. "It's a fulfilling field in that you see the results of your efforts in a finished photograph," he says. "There is an end to photography. It's not just a means to an end."

—Maurice A. DuBois

Give Yourself Credit. . . For Surplus Equipment

Here is an idea that will save everybody money. It was submitted to the employee suggestion system, and the Laboratory has decided to try it out in a pilot program. You can help make it work.

An Exchange Credit Program has been established that would provide a department with monetary credit for releasing equipment to another department. The suggestion focuses on personal computers and video terminals because of current levels of activity.

For example, when a group acquires a personal computer, which can also double as a display terminal, their present video terminal could be declared available for the Exchange Credit Program. Then when other groups are interested in acquiring a terminal, they would review the listing of terminals available, and when their needs can be filled, request a transfer of the equipment. At this point, the requisitioning organization would be charged at one-half the original acquisition value, and the releasing organization would be credited for that amount.

There are several basic rules that must be followed:

- Only DOE-owned equipment is eligible.
- Funds used to effect the credit must be of the same type as the original acquisition, i.e. capital to capital, operating to operating.
- The equipment must be owned by the department/division declaring the item available.

If the program is successful, it will be expanded to include other types of equipment. For now, the focus is on video terminals. If you have an unused terminal, or if you need one, contact your department's property representative, who will get the process started. And keep them in mind for future transactions.

Property Representatives

Department/Division	Administrative	Technical
Accelerator	J. Becker	W. Buckes
	L. Chimienti	P. Hughes
	J. Grisoli	H. Hicks
	W. Harrison, Jr.	H. Lotko
	P. Oster	
	W. Fritz	

(Property Representatives Cont'd)

Department/Division	Administrative	Technical
Applied Mathematics	S.S. Rideout	B.A. Morgan
Applied Science	R. Melucci	E. Pergan
		J. Slavinsky
Biology	H. Marshall	H. Marshall
		P. Asendorf
Central Shops	R. Spellman	E. Jackle
		C. Shiro
Chemistry	N.P. Munhofen	D. Comstock
Contracts & Procurement	J. Haeg	R. Chester
Director's Office	J. Desmond	T. LeMaire
Fiscal	B.J. McAlary	B. Campbell
Instrumentation	C. Williams	C. Williams
Management Information Systems	J. Birtle	J. Birtle
Medical	K. Mohring	T. Smith
National Synchrotron Light Source	W.J. Foyt	B. Fenner
		B. Jones
Nuclear Energy	A.J. Romano	D. Detmer
Personnel	D. Marelli	D. Marelli
Photography & Graphic Arts	J. Laurie	W. Bottinger
Physics	H.R. Manning	E.T. Bailey
Plant Engineering	E. Byrne	J. Hennessy
		J. Iulo
		A. Mahlmann
		J. Rose
Reactor	S. Golden	S. Golden
Safeguards and Emergency Services	H. Kalbach	J. Weynand
Safety and Environmental Protection	H. Kalbach	G. Hughes
Staff Services	W. Webster	N. Pisco
		E. Skrezec
Supply & Materiel	L. DiCarlo	C. McNulty
Technical Information	K. Ryan	J. Heyliger
USDOE	G.J. Ogeka	B.F. Fitzgerald

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In Memoriam

Charles A. Northington died suddenly at Brookhaven Memorial Hospital on July 3, at age 45. A building and grounds utility worker in Plant Engineering, he had joined the Lab in 1973. Northington is survived by his wife Shirley, his four children, Charles, Kathy, Kevin and Mark, and one grand-daughter. He also leaves his mother, Mrs. Nena Northington of Clarksville, Tennessee, four sisters and six brothers. Northington was resident of Westhampton Beach.

Service Awards

The following employees received service awards during the month of July:

Thirty-Five Years

Edward W. Dexter ..... Accelerator
Vance L. Sailor ..... Nuclear Energy

Thirty Years

Robert A. Dryden ..... Accelerator
Eleanor Grist ..... Biology
Carol S. Redvanly ..... Accelerator

Twenty-Five Years

Charles Geonie, Jr. ..... Plant Eng.
Archer J. Post ..... Accelerator
Albert G. Prodell ..... Accelerator
Charles W. Zavesky, Jr. .. Cent. Shops

Twenty Years

Eileen P. Carapezza .. Applied Science
Robert M. DiLello ..... S. & M.
Grace M. Paquette ..... Personnel
Nicholas J. Parrinello .... Accelerator
Veljko Radeka ..... Instrumentation
Henry P. Stemm ..... Central Shops
Samuel A. Wingard ..... Accelerator

Ten Years

Naresh K. Bhagat ..... Applied Science
Alfred S. Campbell, Jr. .... Cent. Shop
Rosemary C. Cohen .... Technical Info.
Dwight A. Dieterle ... Applied Science
Charles L. Dunford ... Nuclear Energy
Lawrence A. Fanella ..... Cent. Shops
Cora T. Feliciano ..... Physics
Willie Hill ..... Medical
James R. Lehmann ..... Medical
Cynthia M. Morgan ..... Plant Eng.
Karen M. Schaich ..... Medical
Janet G. Sillas ..... Director's Offie
David R. Stampf ..... Applied Math.

Arrivals & Departures

Arrivals

Sheila E. Land ..... Plant Eng.

Departures

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

John P. McTague ..... Director's Ofc.

No Parking!

Unless you are in a designated parking area. BNL traffic regulations prohibit parking anywhere else. Even without rules common sense dictates no parking on heavily traveled streets, where parked cars obstruct a clear view of cross traffic and interfere with the movement of emergency vehicles.

Areas of particular concern are both sides of Brookhaven Avenue and the yellow-painted curb at the Cafeteria. In addition, able-bodied employees are seen using stalls marked for the handicapped.

Lab Police will ticket offenders. Parking tickets will be sent to supervisors, and repeat offenders will be dealt with.

Cafeteria Menu

Week Ending August 3

Monday, July 30

French onion soup w/croutons	(cup)	.65
	(bowl)	.85
Southern fried chicken & 1 veg.		1.95
Grilled pork chop w/applesauce & 1 veg.		2.00
Hot Deli: Hot Italian beef	(bread)	1.95
	(roll)	2.10

Tuesday, July 31

Cream of broccoli	(cup)	.65
	(bowl)	.85
Taco platter w/mixed fried rice		1.90
Hungarian beef stew over noodles		2.00
Hot Deli: Baked ham & Swiss	(bread)	1.85
	(roll)	2.00

Wednesday, Aug. 1

Vegetable beef soup	(cup)	.65
	(bowl)	.85
Baked meatloaf w/tomato herb sauce & 1 veg.		1.90
Roast turkey & giblet gray & stuffing		2.00
Hot Deli: Chili dogs		2.00

Thursday, Aug. 2

Chicken okra creole	(cup)	.65
	(bowl)	.85
Spaghetti & meatballs		2.10
Breast of chicken cordon bleu & 1 veg.		2.30
Hot Deli: Monte Cristo		1.90

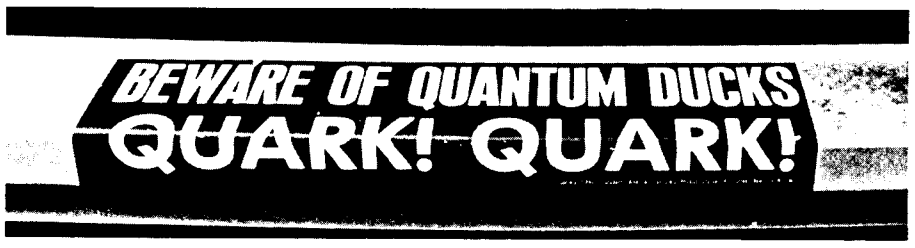
Friday, Aug. 3

Seafood bisque	(cup)	.65
	(bowl)	.85
Pepper steak over rice		2.00
Tuna noodle casserole & 1 veg.		1.90
Hot Deli: Top round of beef	(bread)	1.95
	(roll)	2.10

Child Alert

The BNL summer season is in full swing, and that means many more people on site, among them children who may be charging around on foot and on bicycles. In the interest of safety, BNL drivers should be alert to the presence of these youngsters and drive accordingly. At the same time, parents are asked to see to it that their children stay in the housing area and do not roam around the core of the site.

BUMPER STICKERS PROVE that brevity is the soul of wit. They also tell a little about the people who own the cars they're stuck on. For example, when you bump into the bumper stickers on the top car, you know at once that it belongs to a librarian, in this case Sandi Lane, senior librarian, in the Department of Nuclear Energy. And if you've been keeping up with the particulars of the particle world, you know that the bottom car can only belong to a physicist. This one is owned by Michael Creutz, a high energy theorist in the Physics Department. —photos by Reben



Commemorate the Olympics

A limited number of silver dollar proof coins issued by the U.S. Mint to commemorate the Olympic Games are now on sale at the on-site U.S. Post Office in Building 179. Available for both 1983 and 1984, each coin is enclosed in a display case and sells for $32.

Also, a special edition book, "Golden Moments: A Collection of United States 1984 Commemorative Olympic Issues," is being produced by the U.S. Postal Service. With an introduction by James Michener, the book is dedicated to Jim Thorpe and tells the story of memorable Gold Medal moments in Olympic history. The 76-page hardbound book features all 24 postage stamps and four postal stationery items issued for the 1984 Games. It also includes 32 original, full-color illustrations by artist Robert Peak, designer of all the U.S. 1984 Olympic postage and stationary items. The price of this collector's edition is $20. The set can only be obtained by order, and orders are now being accepted at the Post Office.

BERA News

Children's Program

Happy winners of last week's Friday Swimming Pool Special Event were:

Ages 4 & 5
1st Mikki Bebon
2nd Leron Ilberg
3rd Lidia Vignola

Ages 6 & 7
1st Jennifer Chen
2nd Edward Poggi
3rd Cindy Lin

Ages 8 & 9
1st Kathleen Holden
2nd Jeffrey Chen
3rd Jessica Poggi

Ages 10 +
1st Amie Ilberg
2nd Keith Holden
3rd Cristiana Vignola

Coming Events

Today, July 27 - Relay Races

Next Friday, August 3 - Cup and Ping-Pong Races

Cricket Club

The Brookhaven Cricket Club traveled to Oyster Bay on July 15 to play our perennial opponents, the British Veterans Cricket Club. Batting first, the Lab team scored only 63, Raj Chaudhuri and Glaister Fraser being chief contributors, with 14 and 12 runs respectively. However, against accurate bowling by John Millener (4 wickets for 13 runs) and Chaudhuri (3 for 12), the home team fared even worse, totalling only 50. The Lab team's record is now 1-1, with the final match at home against the Oyster Bay team in September.

Aviation Club

A safety seminar will be held on Tuesday, July 31, from 7-10 p.m. in Berkner Hall. Topics will be automobile fuel and general aviation, followed by a question and answer session to discuss what improvements can be made to provide better FAA service.

The club has planned a flying trip to Mystic Seaport for Friday, August 3, with a rain date the following Friday, August 10. Anyone interested should contact Lou Addessi, Ext. 4758. The cost of flying will be shared and should be about $10-15 per person.

Softball

Games for week of July 16

League I
Phoubars 9 - Ice Pops 8
Blue Jays 23 - Ravens 7
Six Pax 7 - Renames 4
Big Sticks vs. Moles
No score reported.

League II
Games rained out.

League III
E-Z Riders 9 - Farm Team 8
Survivors vs. Nads
No Names vs. Source
No scores reported.

League IV
Septembers 14 - Kidz-R-Us 6
Turkeys 13 - Underalls 10
TNT 8 - Mole-Esters 4

League V
Mudville Sluggers 24 - Erasers 16
No Feedback 12 - Space Kadets 6
Who Cares 16 - Foul-Ups 6

Playoff game:
Who Cares 15 - No Feedback 9
Who Cares is the winner of the first half in League V.

On-Site SCCC Courses - Fall

Course	Cr.	Day	Hours	Start Date
DP11 - Introduction to Computing	3	M/W	5:15-7:05	9/10/84
DP16 - Principles of Computing with Pascal	3	T/Th	5:15-7:05	9/11/84
BA11 - Functions and Environment of Business	3	M	5:15-8:15	9/10/84
BA56 - Personnel Administration	3	W	5:15-8:15	9/12/84
BL71 - Business Law I	3	T	5:15-8:15	9/11/84
AC11 - Principles of Accounting I	4	M/W	5:15-7:05	9/10/84
AC15 - Principles of Managerial Accounting	3	Th	5:15-8:15	9/13/84
EG11 - Standard Freshman Composition	3	T	5:15-8:15	9/11/84
EK22 - Microeconomics	3	Th	5:15-8:15	9/13/84
MA23 - Statistics I	3	M	5:15-8:15	9/10/84
MA25 - Intermediate Algebra	4	M/W	5:15-7:05	9/10/84
ST11 - Oral Communication	3	T	5:15-8:15	9/11/84

Courses are in session approximately 14 weeks.

Registration: August 13-24, 1984 - Building 185 (Personnel).

Tuition: $43.00 per credit (for first time students there is a $20.00 application fee). Visa, Mastercard, checks, and money orders are accepted.

Information: Pat Knisely Ext. 4262.

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 Personnel Placement Supervisor, Ext. 2882.

LABORATORY RECRUITMENT: Opportunities for Laboratory employees.

2087. MECHANICAL ENGINEER - Requires BS or MS in mechanical engineering with a minimum of 10 years' relevant experience in most of the following areas: high vacuum systems, pressure vessel design, cryogenics, structural design, shop fabrication methods and piping systems. Individual will be involved in the development of superconducting power cables and other new underground transmission methods. Accelerator Department.

2088. MEDICAL ASSOCIATE - Requires BS in biology or equivalent. Individual will be involved in investigation of biological effects of electromagnetic fields. Duties include animal weighing, record keeping, maintenance of animal and cage logistics, movement of heavy animal cages, data entry and extensive microscopy. Experience with laboratory animals is highly desirable. Reporting of No. 1974.

2089. SECRETARIAL POSITION - Requires AAS degree in secretarial science or equivalent and excellent typing and communication skills. Work involves extensive typing of mathematical manuscripts for a research group. Willingness to learn computer-based technical typing system necessary. Applied Mathematics Department.

Autos & Auto Supplies

69 PLYMOUTH VALIANT - 6 cyl. auto., p/s, 4dr., runs excel., body fair, interior good, $350. 924-8224.

82 DODGE "RAM" PU - F/S bed, 1/2 ton, am/fm, stereo cassette, cust. 150, low miles, $6,500. 475-7970.

83 CHEVY PU - 3/4 ton, w/'80 coachman camper, $13,500. 399-1868 after 6 p.m.

71 PLAYMOR CAMPER - 17 ft., single axle, dual water, lights, sleeps 5, canopy and more, $1,700. 369-2289.

74 FORD TORINO WAGON - a/c, p/s, p/b, low original miles, very good cond., $1,500. 744-4611 after 6 p.m.

72 OLDS 98 - some rust, new tires, runs well, asking $600. Marian, Ext. 3999 or 282-3129 eves.

76 DATSUN B-210 - 30+ mpg, 52K miles, runs good, 4 spd. trans., asking $800. 744-2715.

73-84 PU CHEVY - front bumper, $60; rear step bumper, $75; mirrors st.st., $30; all new. Ext. 2462 or 269-9510 after 7 p.m.

69 BUICK LA SABRE - 4 dr., V8, a/t, p/s, p/b, a/c, runs well, needs work, $200. John, Ext. 3292 or 286-1348.

VESPA BRAVO MOPED - Super Deluxe, Class B, excel. cond., used very little, $500. Lloyd, Ext. 3381 or 286-1024.

79 HONDA CX500 - custom, water cooled, shaft drive, $900 firm. 929-6543 after 6 p.m.

74 TOYOTA PU - Hi-Lux model, with cap., white, new paint, $1,875. 724-4382 after 6 p.m.

75 BUICK - 4 dr., 350 engine, auto., p/s, p/b, new tires, new parts, reliable transp., good cond., $1,000. Walter, 878-8967.

78 CB550 HONDA MOTORCYLE - excel. cond., many extras, $975. George, Ext. 7654.

FORD 250 C.I.D. - 6 cyl., 70K, runs excel., complete, w/tranny, $225. Betty, Ext. 2937.

68 COUGAR - new front end, needs work, Ford motor parts. Rich Chernis, Ext. 3499.

78 MUSTANG - 4 spd., 65K mi., very good cond., $2,700 or best offer. Boyce, Ext. 3734 or 744-7849.

72 FORD PU - 3/4 ton, 4x4, w/71 Franklin/foot slide on camper. 924-4058.

HONDA XR80 - dirt bike, excel. cond., $400. Neal, 286-2435.

75 YAMAHA MOTORCYCLE - RD-250, 13,000 mi., look and runs like new, $725. Andy, Ext. 2907 or 929-4850.

72 TROTWOOD BUNKHOUSE - 27', air cond., sleeps 8, $350; 69 21'-fan travel trailer bunkhouse, needs some work, $1,700. Mike, Ext. 2976 or 732-2309.

79 FIAT 124 - Spyder 2000, conv., 5 spd., am/fm stereo, asking $3,650. Ext. 5182 or 924-5513.

81 DATSUN 310 GX - hatchback, 4 spd., am/fm cassette, 43,000 mi., dark red, excel. cond. Sutin, 286-8528.

BATTERY CHARGER - exide commercial, charges 1-6 batteries at one time, adjustable charge rate, $50. Walter, 878-8967.

75 HONDA MOTORCYCLE - Goldwing, many extras, excel cond., heavy chrome, $1,500. Mike, Ext. 2976 or 732-2309.

68 DATSUN ROADSTER - SPL311, conv., excel. cond., must see, $3,500. Chris, Ext. 7782 or 929-6543 after 6 p.m.

78 CORVETTE - loaded, black w/white int., mint cond., $9,500. Jack, 757-1380.

66 FORD FAIRLANE - G&A, rebuilt 390, 6 cyl. trans., new paint, tires, interior, $1,650. 924-5079.

78 MERCURY MONARCH - 6 cyl., p/s, p/b, a/c, very good cond., asking $3,000. 221-6636.

TRUCK CAMPER - 10-1/2' Frolic, sleeps 6, fully equipped, $500. Carl, Ext. 3507 or 286-8794.

63 CHEVY BELAIR - 6 cyl., runs well, 90K orig. mi., $400. John, Ext. 3292 or Mark, 286-4150.

75 HONDA MOTORCYCLE - CB200T, excel. cond., hardly used, great gas, asking $400. 286-2964 eves.

81 HARLEY DAVIDSON - 1,000 cc, Sportster, very low mi., like new. 929-3455.

69 VW BUG - $300. 689-7388 eves.

66 FORD MUSTANG - 6 cyl., auto., good cond., asking $800. 286-2964 eves.

76 DATSUN B210 - good running cond., 30+ mpg, $700. 744-2715.

69 BUICK LA SABRE - 4 dr., auto., V8, 2 new tires, runs well, $200. John, Ext. 3292 or 286-1348.

81 KAWASAKI MOTORCYLE - 440 LTD, black, low mi., must sell, $1,000. Greg, 289-6519.

75 FORD MUSTANG - 4 spd., good cond., $700. 472-4228.

68 VW BEETLE - asking $600 or best offer. 589-5490.

71 MOTOR HOME - 22', new generator, a/c, shocks, excel. cond. Ext. 4597 or 878-1255.

72 MUSTANG FASTBACK - a/t, a/c, good cond., $850. 878-0207.

65 HONDA MOTORCYCLE - 65 cc, complete, extra front & rear wheel, runs, $200. Bill, Ext. 4988 or 698-4882.

78 MOTORCYCLE - KZ400, recent dealer tune-up & service, many new parts, very good cond., $900. Ext. 7148 noon.

80 KAWASAKI MOTORCYCLE - 440 LTD, runs well, rooster, fairing, stereo, new tire, sprockets, chain, $700. 399-0168.

74 FORD PINTO - new clutch, tires, a/c, stereo, $95. Ext. 2675.

80 FORD MUSTANG - 39K mi., new tires & brakes, am/fm cassette, excel. cond. in & out, asking $4,500. 744-5578.

72 FORD F-250 PICKUP - 4x4 w/71 Franklin 11' camper, $3,000. 924-4058 after 5 p.m.

71 PONTIAC GRANDVILLE - V8, a/t, p/s, p/b, good running cond., must sell, $375 or best offer. 282-3855.

Boats & Marine Supplies

RATHYEON CHART - & flasher recorder, $150. John, Ext. 4312.

23' O'DAY - keel, centerboard, 4 sails & spinnaker, cruise equipped, cabin raises 6'3", $48,500. 288-3138.

18' RUNABOUT - fiberglass, 90 HP Mercury, alum. trailer, many new parts, will demonstrate, $2,400. 744-5143.

21' T-CRAFT - 1972, w/trailer, VHF, Porta Potti, 307 Chevy, OMC. I/O, canvas, excel. cond., $5,500. Ext. 3319 or 744-9802.

19' RENKIN - 1976, new back-to-back seats, 115 HP Evinrude, 1981 Shurline trailer, power winch, $3,500. Otto, 472-0339.

SAIL BOARD - Magnum Nova, lightly used, $375. 689-7388 eves.

19' CRUISER INC. - fiberglass, w/90 HP Chrysler, trailer, many extras, excel. cond. 325-0447 after 6 p.m.

28' OWENS - very good cond., stand up head, sink, stove, table, sleeps 4, all needed equipment, $3,000. Ext. 7148 noon.

Miscellaneous

FABERWARE - convection oven, good cond., $90. 929-8443.

BICYCLES - (1) men's, (1) women's, $15 ea.; exercise bike, $40. Janet, Ext. 2345 or 929-8152.

SOFA-BED - brown, naugahyde, double, $50; (8) stack-chairs, $100 firm. Ext. 2604.

BICYCLE - suitable for girls age 6-10, red. 2-wheeler, good cond., $30. 929-6442.

AIR CONDITIONER - Westinghouse, 10,200 BTU's, 1375 watts, $125; Sears air conditioner, 6,000 BTU's, $75. Henry, Ext. 3084.

STEAK KNIVES - (6) serrated, $15; (2) canvas wood frame bench back rest & seat, $5 ea.; (2) beach & bath towels, striped, 36"x54", $4 ea. 654-3781.

CB - 23 channel, 5 watts, antenna and holder, good cond., $25. Susan, Ext. 4267.

POOL FILTER - sand w/6 function, 1 HP motor, sacrifice. 475-6938.

TENT MORSAN - 7x7, like new, $65; Franklin wood stove, $50. John, Ext. 4312.

COT - $15. 744-9677.

UPRIGHT FREEZER - 19 cu. ft., $100; 40 channel base CB, $100; Atari video game & 10 cartridges, $100. Harry, Ext. 7578.

PENTAX K LENS - 50 mm, F2, UV filter for lens. Sandi, Ext. 3559.

PVC DARKROOM SINK - 72"x27", splash board, print drying racks, cabinet underneath, excel. cond., $250. 732-6822.

MARINE AQUARIUM - 135 gal., fully equipped, cabinet, coral, A stock, over $2,000 invested, asking $1,500. 475-1388 eves.

SUITCASE - Samsonite, yellow, 24"x19", $40. Lou, Ext. 4364.

WATER PURIFIER SYSTEM - Mark 50, Sears, glasslined water tank, 42 gals. & Sears shallow pump, $100 for all. Katherine, 281-8021.

OVERHEAD GARAGE DOOR - 8', steel. 878-1148.

POP-UP CAMPER - Starcraft, heater, sove, sink, sleeps 6, best offer. Jack, 757-1380.

SKY KENNEL - for small dog when traveling by plane. Al Campbell, Ext. 2043.

ATARI 2600 - Sears video game w/4 cartridges, $60; video game cart holds console & cartridges, $20. Ext. 4483.

MAGNAVOX STEREO - hi/fi console, good cond., nice piece of furniture, good sound, $150. Lloyd, Ext. 3381 or 286-1024.

BICYCLE - Vista woman's 10 spd., 21", very good cond., $80. Ext. 7112 or 472-1922.

REFRIGERATOR - 14 cu. ft., top freezer, bottom refrig., good cond., brown, $50; galvanized air ducts, various lengths & widths, $50 takes all. 924-8224.

DRESSER - antique walnut, 4 drawer w/good mirror. Walt, Ext. 7154.

POOL LADDERS - (2) stainless steel inground pool ladders, (1) 10' diving board, good cond., $60 all. Joe, Ext. 2957 or JU1-5827.

UPRIGHT FREEZER - Sears, 25 cu. ft., good cond., new door, gasket & paint, $200. Walter, Ext. 2352.

BICYCLE - BMX Mongoose, racing pads, excel. cond. Neal, 286-2435.

DIAMOND RING - beautiful marquis, (2) bagettes, total 1.0 pt., appraised at $3,125, asking $2,400. Mary Ann, 286-2435.

UTILITY CABINET - metal, 18"w x 72"H, $10; 16 qt. pressure canner, $25; painted chest of drawers, $20; hand lawnmower, $10. 878-6637.

AUTO STEREO - am/fm cassette player, in-dash installation, like new, $30. Dick, Ext. 2911.

TECHNICS CASSETTE DECK - RS-M224, Dolby NR system, metal tape, brand new, box never opened, $120. Bob, Ext. 4656 or 928-1806.

HIDE-A-BED - Simmons, sofa w/beauty rest mattress, plaid weave, good cond., $180. 924-0848.

KROEHLER SOFA - 90", modern, 4 seat, yellow floral design, excel. cond, $150. 363-2070 eves.

MOTO-X BOOTS - Scott boots, black/yellow, fit sizes 9-13, used 3 times, like new. Andy, Ext. 2907 or 929-4850.

OXYGEN MACHINE - Bunn Best, lightest, like new, cost $3,005, best offer. 929-4701 or 929-8105.

MATTRESS/BOX SPRING - single bed, allergy free. 281-2002.

GUITAR AMPLIFIER - Guild Model 2; hardly used, make offer. Ext. 7112. or 472-1922.

MINI-BIKE - 3.5 HP, shocks, knobbies, excel. running cond., needs minor work, $150. 475-1388 eves.

DRILL MOTOR - 1/2", Black & Decker, 375 RPM w/1/16"-1/2" drills & index, asking $50. Katherine, 281-8021.

WURLITZER ORGAN - Spinet, solid cherry, model 4300D, multimatic percussion, excel. cond., $900. Lloyd, Ext. 3381 or 386-1024.

POT BELLY STOVE - antique, coal or wood, excel. cond., $100; (2) bdrm. dressers, $50. 924-8229.

LOLLY COLUMNS - adjustable 6'-9', various tonnage, several sizes & types avail., $7-$20. Walter, 878-8967.

NATIONAL GEOGRAPHICS - 1962-1984, best offer; 1" rechargeable TV battery, best offer. 929-4701 or 929-8105.

MINK COAT - full length, white & fawn, appraised at $2,250, must sell, $600. Ext. 7782 or 929-6543 after 6 p.m.

TRUMPET - used 6 months, excel. cond., asking $200. Ext. 7672 or 727-1667.

FM/AM STEREO - Garrard turntable, 12" Americana speakers, 6-1/2' Barzilay cabinet, best offer. Marian, Ext. 3552.

POOL - little tikes blue pool, has plug, 2 seats & slide, used 1 yr., $10. 878-4128.

FOLDING BICYCLE - Italian Chiorda, perfect cond., new tires, excel. for traveling & camping, $75. 581-6432.

SCHOOL DESK - solid pine, Colonial, w/pine chair, bookshelves, excel. cond., $50. 281-2731 eves.

STEREO SPEAKERS - w/enclosures, plus 12" full range, 8 ohm electro voice speaker; Fisher stereo console, make offer for all or part. 744-9832.

PICK-UP CAMPER - 11', slide-in, self contained, sleeps 6, alum., step bumper, excel. cond., $2,395. 821-1081.

REFRIGERATOR - dormitory size, excel. cond., $68. 475-4394.

MINOLTA LENS - 24 mm 2.8, & Minolta Macro extension, 100 mm 3.5, $130 for both. Ext. 3942 or 727-1412.

LAWN MOWER - manual push-type, Sears lightweight model, $25. Ext. 3809 or 744-8609.

TABLE LAMP - blue glass base, $5; pedestal table, 24" dia., mahogany, $15. Nancy, Ext. 5274 or 281-2767.

SLIDING DOORS - (3) wood, 32"x6-1/2', $10 ea. 281-7844.

ROTO-TILLER - w/snow plow, 5 HP, pneumatic wheels & chains, $400 neg. Otto, 472-0339.

FORSYTHIA CUTTINGS - & pots, start your own bushes. Walt, Ext. 7154.

WINDOW FAN - GE, 20", $18; crock pot, $5; quartz heater, $15; oak table top, $40. 689-7388 eves.

ELECTRIC ORGAN - Bontempi, w/bench & music, single keyboard, $125; dresser/dressing table & night table, $160. 286-8517.

CARPET - 10'x11', brown shag w/extra strips & carpet padding, $40. Dave, Ext. 4254.

TOURING BICYCLE - Schwinn Continental, 10 spd., 1980, excel. cond., 25" frame, $125 or best offer. 698-1676.

MEN'S BICYCLE - 10 spd., good cond. Sue, Ext. 3612.

KITCHEN CABINETS/COUNTERTOP - 8', like new, wood/broom closet, $300. 567-4333 days or 475-3792.

STEREO FREQUENCY EQUALIZER - ADC, 5 band/channel, 60, 240, 1,000, 3,500, 10,000 Hz, tape monitor, $40. 924-0813.

LAWN MOWER - Sears, 21", rear bagger, $100. Ext. 3294.

FIREPLACE SCREEN - $15; Sears Kenmore sewing machine & cabinet, $30; (2) 10 spd. bicycles, $10 ea. Victor, Ext. 2395.

LIVING ROOM TABLES - set, coffee table & end table, glass top, chrome frame, $50. 924-8226.

CREAM SEPARATOR - George, 744-3289.

BMX CYCLE - Supergoose, mint cond., many extras, new parts, must see, $225 firm. 744-1917.

VIOLIN - 1/4 size, Suzuki, bow & case, $150. Ext. 3828 or 751-7250.

STEREO RECEIVER - amplifier, Pioneer, SX-636, $75. Ext. 2041.

BEDSPREADS - twin size, red, white & blue, king size, gold & beige, $15 ea. Les, Ext. 2920.

WOOD DOOR - exterior w/glass, 3-9 litres, 30"w x 80"h or 32"w. Bill, Ext. 4988 or 698-4882.

BEDROOM SET - 5 pc.; bookcase, coffee table, desk, best offer. 744-4838 after 6 p.m.

WINDOWS - double hung, used, 36"x54", w/ storms & screens, $20 ea. 744-5096.

MOVING SALE - table, chairs, mattresses, kitchen ware, crib, child's car seat, bike, more. Ext. 3525 or 3107.

AIR CONDITIONER - Fedder's, 7000 BTU, 4 yrs. old, sacrifice; pool filter with 1 HP motor, excel. cond. 475-6938.

Free

DOG HOUSE - 3'x3'x4', you pick up. Ext. 3294.

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 Sale

CORAM - Birchwood at Bretton Woods, 3 bdrm. condo., Dalton, den, formal d/r, 1-1/2 baths, patio, gas heat, central air, 1/2 block to Clubhouse, $100,00. 732-6822.

SHOREHAM - house atop a bluff with spectacular view out over the Sound, 5 rooms, year-round, attractive grounds. 744-9749 eves.

ALBANY AREA - 97 acre farm, large, newly renovated house, 3 bdrms., l/r, kit., den, util. rm., pool, 2 story barn, 3 ponds, panoramic view, 7 mi. to Schenectady, 19 mi. to Albany, $95,000. 698-0576 eves & weekends.

CONNECTICUT - 600 sq. ft., lakefront cottage, 2 bdrms., sun deck, $24,000. Jack, 757-1380.

BROOKHAVEN HAMLET - large cape, formal d/r, l/r w/fireplace, beamed ceiling, country kitchen, 4 bdrms., 2 baths, screened brick patio, garage, landscaped, extras, mint cond., principals, $115,000. 286-1082.

RIDGE - 3 bdrm. ranch, den, 1 bath, l/r w/coal stove, eik, patio, storage shed, alum. siding, large corner lot w/fence, new well, new cesspool, new w/w, min. from Lab, $72,900. Ext. 3565 or 924-8594.

SHOREHAM WATERFRONT - 5 room house, year-round. 544-9749 eves.

MAINE - 18 acres of wooded privacy, great hunting area, $8,000. 878-0207.

For Rent

GORDON HEIGHTS - 1 bdrm. apt., furnished, 2 private entrances, share patio, utilities included, no children or pets, references, must see. 698-1362 after 5:30 p.m.

RIDGE - 2 bdrm. townhouse, 1-1/2 baths, washer/dryer, dishwasher, no pets, preferably no children, avail. Aug., $550/mo. plus util. Betsy, Ext. 5182 or 924-5513.

MOUNT SINAI - furnished room w/new carpet, desk, bed, etc., $300/mo., 2 meals avail. w/additional $300. 331-4648.

BELLPORT AREA - month of Aug., 1 bdrm. apt., 1 block from Marina, tennis, swimming pool, beach, weekly housecleaning included, pets & children neg., $1,300, weekly rental considered. 289-9724.

NORTH PATCHOGUE - kitchen, bath, l/r, w/w, cable hook-up, private ent., no kids, no pets, $425 pays all. Carol, 289-3917.

MASTIC PARK - 2 bdrm. apt., $425 w/heat, security, references. 281-7844.

VERMONT - 3 bdrm. house, reasonable vacation, 2 baths, f/p, fully equipped, woodland trails, alpine slide, golf, summer theater, boating, fishing, etc., family oriented, avail. weekly. 732-6499 after 6 p.m.

MIDDLE ISLAND - 3 bdrm., 1-1/2 bath, washer/dryer, dishwasher, f/p, furnished, comfortable residence on secluded 4 acres, w/private pond, 5 min. from Lab, $800/mo. 924-7480 after 6 p.m.

Wanted

HOUSE TO RENT - or sit, all or part of August, responsible couple. Tom, Ext. 4662.

FLUTE - used, good cond., reasonable. Pion, Ext. 3639.

STEREO AMP - 200 watts, min. mixer equalizer; machinist tool box; stereo cassette deck, good quality. 589-0819.

ELECTRIC ROTISSERI - 281-2002.

RIDING MOWER - elec. start, 8 HP or larger. Jack, 757-1380.

HOME FOR CAT - moving, need good home for neutered male, lovable, affectionate, well trained. Liz, 286-0913.

GO CART - used, for 10 yr. old, will repair if necessary. 929-3455.

AUTO SERVICE MANUAL - for 1977 Mercury Cougar XR7. John, Ext. 3292 or 286-1348.

CAMPBELL'S SOUP LABELS - send to F. Chandler, Bldg. T89, for St. Mary School, E. Islip.

WROUGHT IRON FURNITURE - Ext. 3565 or 878-2233 after 6 p.m.

SMALL COLOR TV - $100 or less. Ext. 4490 or 289-9724.

HOUSE TO RENT - 2-3 bdrm., unfurnished. 929-3455.

OUTBOARD MOTOR - 2-3 HP, running, reasonable, repairable O.K. Bill, Ext. 3848 or 281-6498.

TO RENT OR HOUSE SIT - retired couple needs place all or part of August. Ext. 4192.

Ads left out of this issue due to lack of space need not be re-submitted to appear in the next issue.

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