BROOKHAVEN BULLETIN
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BROOKHAVEN NATIONAL LABORATORY

BNL/CCNY Team Claims Glueball Discovery

"The early physics will be the ultimate test." — Sam Lindenbaum, group leader of the High Energy Particle Spectrometer Group, in April 1982, in reference to the testing of MPS II, the Multiparticle Spectrometer upgraded to be ten times more powerful than its predecessor, MPS I.

When the first experiment was run on MPS II last spring, it was actually a two-pronged test. The early physics of experiment 747 tested both the capabilities of MPS II and a key premise of the high energy physics theory known as Quantum Chromodynamics (QCD). As the test physics results have come in, not only have they confirmed the unique value of MPS II, but they have also provided direct evidence for glueballs, whose theorized existence has been a cornerstone of QCD.

Sam Lindenbaum represents both BNL and City College of New York (CCNY) on 747, a BNL/CCNY collaboration experiment that utilizes the MPS II and the AGS. On the basis of 747's experimental data, he says, "We are quite confident in claiming the discovery of glueballs. I believe that any 'discovery conclusion' is based on certain assumptions, and that a 'discovery conclusion' is more probably correct if the axioms are simple. Our claim for glueballs is based on two rather simple assumptions. First, that QCD is correct. There's a large body of evidence for this, and if you don't believe in QCD, talking about glueballs is irrelevant in the first place. Second, that the phenomenon known as Zweig suppression is universal in the absence of glueballs, and this has been strikingly demonstrated in all tests so far. I feel that this is as simple an argument as can be made, and we have found that most experts now agree that we have the best evidence for glueballs."

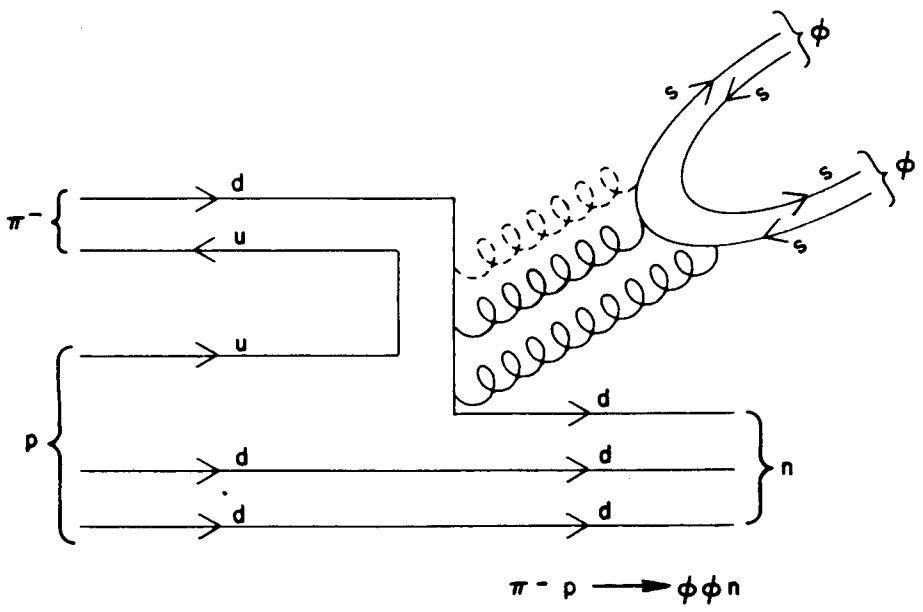
Glueballs, as predicted by QCD, are a direct result of strong interactions, the forces that keep quarks bound together. Quarks are fundamental particles, that may come in any of three colors (hence, *chromo*dynamics). Quarks are never alone; they join together, combining their colors to form colorless, or white, pairs or triplets. So strong is the force holding the quarks together that they are said to be confined. That very strong force resides in other fundamental particles known as gluons. These spring-like particles also carry a color charge and couple to the quark colors, becoming the glue that confines quarks very closely to one another.

QCD predicts that gluons must self-interact, joining their colors to form white clumps of gluons, or glueballs. Lindenbaum calls these glueballs "QCD's missing link" because finding them confirms so much about that theory. "If we could explain all physics laws with these simple gauge theories, that would be a tremendous accomplishment," says Lindenbaum, adding, "If you don't have glueballs, then QCD is in trouble."

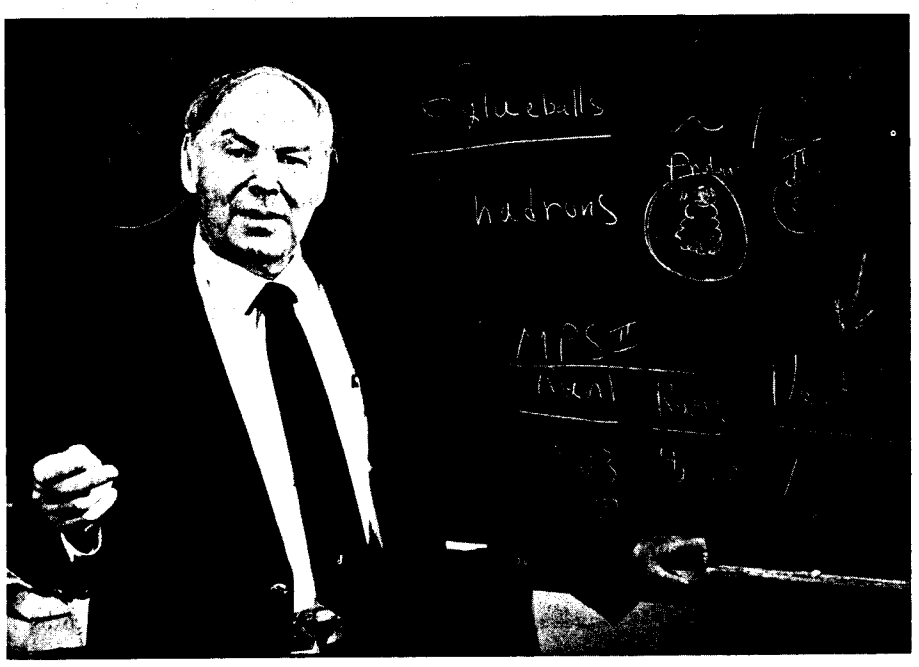
But how does one find a glueball? "It's like looking for a needle in a haystack," said Lindenbaum. "Quark states have much bigger cross sections for being formed, so when you look at a swarm of particles, the quark states mask the glueball states and make them hard to identify. You need an electromagnet to pick the needle out of the hay."

For an electromagnet, Lindenbaum chose the 700-ton, C-shaped giant at the core of the Multiparticle Spectrometer, with its associated sophisticated reaction selection equipment, and looked for a reaction that was Zweig-suppressed. In QCD, there is an observed selection rule called Zweig suppression, or OZI, without which, Lindenbaum says, the discoveries of such particles as the narrow phi, J-psi and upsilon could not be explained. Zweig suppression comes into play at high energies, when the coupling constant between quarks and gluons weakens, yielding what Lindenbaum terms "pure glue," intermediate states in the Zweig-suppressed reactions. Quark states in this channel cannot pass the barrier imposed by Zweig suppression. But QCD predicts that glueball states can.

Given these basic tenets, Lindenbaum and the 747 team formed this argument: if one believes in QCD and, therefore glueballs; and if one believes that the Zweig suppression is universal so that glueballs are the only states that can overcome Zweig suppression; then any state that overcomes that barrier must be a glueball.



This quark line diagram depicts the reaction through which experiment 747 has identified glueball states. A collision between a negative pion (π^-, made of one down quark and one up antiquark) and a proton (p, made of two up quarks and one down quark) yields a neutron (n) and two phi (ϕ, made of one strange quark and one strange antiquark) particles. The ϕ's are said to be disconnected, a situation which is OZI-forbidden. The data show a breakdown of the Zweig suppression by glueballs. The spring-like spirals are the gluons which make up the glueballs.



Mort Rosen

Sam Lindenbaum

The first attempt to find a glueball took place in 1978 using MPS I. "We found evidence then that the Zweig suppresion broke down just like we had argued it would," says Lindenbaum, but MPS I didn't give us enough data to identify any of the usual quantum numbers. And in 1980, a team at SLAC said they had found a glueball candidate but they could not reduce their claim to simple axioms, and opinions as to whether it could be a glueball differ widely and strongly."

The real breakthrough came in the spring of 1982, shortly after MPS II went on line. In MPS II, the spark chambers of MPS I were replaced with drift chambers capable of gathering ten times more data. "We redid our 1978 experiment, studying a Zweig-suppressed channel with MPS II," Lindenbaum says. "With the much larger data sample we got, we were able to explicitly identify two states that are due to at least one primary glueball, and possibly two. We are able to say this because with MPS II we could pick out the two states and have all the quantum numbers, such as the isotopic spin [0], parity [+], angular momentum [2], G parity [+], charge [0], mass [2.16 and 2.32 GeV], width [0.31 and 0.22 GeV] and ratio of the d and s wave content. This I call a discovery of glueballs, since our conclusion is based merely on modern QCD practice."

Besides Lindenbaum, others on the BNL/CCNY team are Chang Chan, Asher Etkin, Ken Foley (deputy group leader), Marty Kramer, Ron Longacre, Bill Love, Tom Morris, Ed Platner, Vinnie Polychronakos, Al Saulys, Yoshiki Teramoto and Dean Wheeler. To reinforce and add to the evidence for glueballs collected last year, they have concluded another run with MPS II, and have just analyzed their new data. The original two states due to glueballs were confirmed and a third has been found.

Lindenbaum is confident of the glueball discovery claim. "I've worked in strong interactions all my professional life, and I've found that the best way to make progress in physics is to follow simple axioms, as long as they work, and to do critical experiments to test them," he says. "That's what we have done, and there's a growing concensus that we have the strongest case for glueballs. Those who think otherwise must be quarreling with one of our two assumptions, because given those two axioms, which merely represent modern QCD practice, there is no possible explanation for our results other than glueballs."

—Anita Cohen

Tandem Accelerates Carbon-14 Beam

On June 27 the first beam of radioactive carbon-14 ions was accelerated through the Tandem. Because carbon-14 has the highest neutron to proton ratio between lithium and calcium, various neutron rich compounds can now be studied.

The ion source, which supplies the ions for the beam, was developed by Mike McKeown of the Tandem operations group, headed by Peter Thieberger. Two groups are currently conducting research with the beam; one from BNL (Peter Bond and Rich Casten) and the other from Stony Brook. It marks the first time that the Tandem has accelerated a beam of radioactive ions; it has already accelerated 65 other types of stable ions.

Of the four carbon-14 beams in the world, the BNL beam has the highest energy. The other three are at Los Alamos National Laboratory, the University of Munich and the University of Orsay.

This month, DNE Department Chairman Herbert Kouts was given two additional responsibilities. At BNL, he was appointed Acting Associate Director for Applied Research. In this capacity he will oversee the Lab's programs in nuclear energy and applied science. And he has been designated a member of the Fact Finding Panel on the Shoreham Nuclear Power Plant. The Panel has been formed to advise Governor Cuomo on the start-up of this controversial plant.

Summer School Summary

"The future lies with the young and we must have schools to nurture that." That's how physicist Melvin Month summed up both the purpose of the 1983 Summer School on High-Energy Particle Accelerators, which ran at BNL and SUNY Stony Brook from July 6—16, and the reasons why so many world-renowned physicists participated in the program. This theme was reiterated by many observers during the Summer School and formed the basis of remarks made to the students by Laboratory Director Nicholas Samios at the concluding luncheon last Saturday.

Speakers at the 1983 Summer School on High-Energy Particle Accelerators included Carlo Rubbia, Harvard and CERN, (above) and William Wallenmeyer, DOE, (below). —photos by Humphrey

The announcement of HEPAP's recommendation to stop CBA and push for a superconducting super collider, "gave the Summer School an impact that wasn't completely recognized when we began planning it a year ago," said Month, who was both Deputy Director and Chairman of the Organizing Committee for the school. By focusing on the future of the field, the school helped the students to put things into perspective. "The young people seemed to sense that the future belongs to them and it is they that have to develop the expertise required to build and operate very high energy devices," Month said.

"This is a time of great discoveries and great ideas in high energy physics," he added. "The whole group was very positive, but the young people especially brought to the school an inspiring optimism about the field."

For each morning session, the 150 school participants met at SUNY Stony Brook for rigorous courses concentrating on various aspects of the work involved in creating high-energy particle accelerators. In the afternoon and some evenings, the future leaders in this field gathered at Brookhaven to listen to some of the present leaders explain what that hard work will be for.

"We wanted the school to represent high energy physics as a world discipline," Month said. In this regard, the highlight of the Summer School was last Friday night's round table on an ultrahigh-energy collider. The panelists included Gus Voss, Discussion Chairman and Director of the particle accelerators at DESY; "BJ" Bjorken, a renowned theorist from Fermilab; Carlo Rubbia, the Harvard experimentalist whose CERN team may have found the W and Z particles; Maury Tigner of Cornell, an expert in accelerator physics and technology; BNL's Paul Reardon, Director of the Summer School who is well-known for his expertise in design, construction and management of large, high technology projects; and Doug Pewitt, of the Executive Office of Science and Technology, who offered the government's view.

"It turned out to be an exceptionally exciting discussion," said Month, "The overall effect was of people who were really thinking hard about this new ultrahigh-energy collider, and how one would approach building it. Each panelist said, in his own area of expertise, things would have to be done differently than in the past. But, with commitment and desire, they all believed it can be done."

The school, the third in a series of national summer schools, was sponsored jointly by BNL, the Department of Energy, the National Science Foundation and SUNY Stony Brook.

Instrumentation Repair Group: Tom Stuart, George Sintchak, Frank Rizzo, Doug Clareus, Ralph Perry, Frank McNulty, and Frank Drell.

Doug Humphrey

Instrumentation's Mr. Fix-its

Scientists can't use broken equipment. They have two alternatives - either fix it themselves or bring it in for repair. But trying to fix it themselves sometimes leads to bringing it in for repair. And the down time goes up.

"We'd prefer they bring their instrument to us first," says George Sintchak, supervisor of the Instrumentation Repair Group. "Otherwise clear symptoms of what's wrong are disguised. A very simple problem can then turn into a complex one."

Most BNL scientists and technicians, however, only go through cursory checks to see if a part is burned or if a battery is dead. They then have the option of either dropping off their oscilliscopes and power supplies at the repair shop or calling for one of seven in Sintchak's group to look at a multichannel analyzer, an x-ray machine or a spectrophotometer.

After the problem is diagnosed, there are two choices - either repair the instrument on site or send it out. "Every few years we review our records to see what is more economical for the Lab, " says Sintchak. "Sometimes it's a question of time. If we know the repair will take several days or require special parts, we'll send it out."

The easiest instrument to fix is a dead machine. Usually the problem is a blown fuse, a bad integrated circuit, or a loose wire. And most of the parts, which are inventoried in a desk-top computer, are located in a lazy susan in the middle of the shop. If a part isn't available, it's specially ordered or is picked up from an individual department's repair group, such as the AGS which has enough equipment to maintain its own group.

There was no Lab-wide repair group ten years ago. To be sure, there were individuals responsible for repair, but mainly only in the larger departments. At that time the repair shop was consolidated in one area and was combined with the Central Instrument Pool.

There was another change six years ago when intra-lab requests were no longer used to bill departments for repair. "It would take five minutes to replace a fuse and thirty dollars worth of paper work," says Frank Drell who repairs NIM modules, ionization gauges and power supplies. Now, the Lab completely finances the shop, and a department is charged only when a repair's cost exceeds a certain amount.

"How long will the repair take?" is a common question. Says Sintchak, "It depends on the situation. A few years ago we helped assemble a fifty kilowatt vibrator for DNE to test reactor piping systems under earthquake-like conditions. Every time we tested it, it would kick out the power until we finally got it to work after two weeks. The janitor was in the bathroom and the seat began to rumble."

A more challenging repair. A broken rat flusher. "I didn't like being in there with those rats, " says Frank McNulty who works mainly with biology and medical equipment and repairs the HP-85 microcomputer. "One year I went there four times until a wall was finally built so I could fix it from the outside. I don't like rats."

Frozen chickens, however, were valuable to Doug Clareus as barter with natives of the Marshall Islands. From 1961 to 1977 he spent two months each year on the islands maintaining the equipment used by the medical group to monitor the effects of the 1954 bomb tests.

He came to the Lab in 1947. "I was working in the city as an engineer when one day I read about Brookhaven starting up. I went out to see what was going on. I told my buddies to get out of the city rat race and bring up their children on the Island."

Some came and, except for Clareus, all have retired. He's gone through the change from tubes to solid-state to integrated circuits to microcomputer chips. He doesn't mind though. "It has been a learning experience."

Manufacturers now supply tapes and videotapes. "We sit down in the lunch room and go step by step with the instructions, " says Ralph Perry who handles oscilloscopes, other CRT display terminals and photography equipment. "You have to be more than an engineer to fix these things today."

Before coming to BNL 27 years ago, Perry was a carpenter. "I got no satisfaction building houses because every one was the same. Here every day is different." He has been surprised by a groundhog under a building where he was installing an intercom and by flashbulbs on trigger busses, also under a building.

The group also offers advice on equipment. Last May the Instrumentation Division sponsored a Multichannel Analyzer Equipment and Application Demonstration at Berkner Hall. The instrument identifies energy spectrums of radioactive isotopes.

"Electronics is wonderful. It works until it breaks," says Tom Stuart who repairs the analyzers. "And then the scientists, especially the superstitious ones, only want their equipment fixed and won't settle for a replacement or a temporary loaner."

... which can cause problems for the repair group. Says Frank Rizzo who's been handling CRT terminals, RF equipment and the Central Instrument Pool for 28 years, "Some days we have good days and other days we pull our hair out and get nowhere."

But generally they keep everyone happy. Says Drell, "We can fix anything but a rainy day."

— Steve Eisenberg

Concert Notice

Elisabeth Palmedo, soprano, and Helen Wilkinson, mezzo-soprano, will present a concert on Wednesday, July 27, at 8:30 p.m. in Berkner Hall. The singers will be accompanied by pianist Pamela Ross.

Tickets will be available at the door. General admission is $4; students and senior citizens, $3.

In Memoriam

Philip R. Davis, a Sr. Administrative Assistant who managed the stockroom at the Chemistry Department, died on July 14. He was 56 years old. Davis had been with the Chemistry Department since his arrival at the Lab on July 27, 1948. He was a resident of Port Jefferson, and is survived by a brother, Judson of Calverton.

Vacation Carryover

If you're accruing vacation time in excess of 31 days and haven't yet made plans to use up the excess, be aware that time is running out. As announced by the Director last year, vacation carryover must be reduced to 31 days by the last pay period in September. If not, the excess days will be lost. Therefore, all employees should reduce their vacation balance to 31 days or less by September 23, 1983. This includes vacation days accrued during the month of September. Any exceptions to this policy must be approved by the Director.

Sunday Tours

10 a.m. — 3 p.m.

Through September 25

(Except September 4)

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CREF Values

July	42.41	August	47.05
September	47.32	October	52.59
November	54.78	December	55.73
January	57.59	February	58.93
March	$60.75	April	$65.12
May $65.07			

June $67.12

Art Show

Prints by Fairfield Porter will be the focus of an art show that opens July 25, at 4:45 p.m., with a wine and cheese reception in Room B, Berkner Hall. The show will continue through August 5, weekdays only, from 11:30 a.m. to 1:30 p.m.

Camera Club

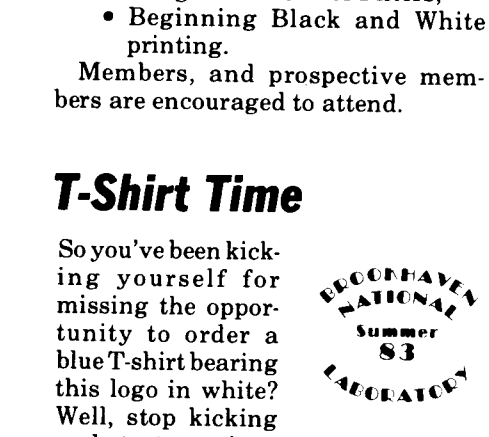
The next meeting of the Camera Club will be on Thursday, July 28 at 5:30 p.m. in the Recreation building. The program will focus on:

- Imaginative Use of Filters,
- Beginning Black and White printing.

Members, and prospective members are encouraged to attend.

T-Shirt Time

So you've been kicking yourself for missing the opportunity to order a blue T-shirt bearing this logo in white? Well, stop kicking and start running — to beat the *new* deadline for ordering one — August 5. If you'd rather not run, you can send your order to Renee Flack, Bldg. 460. Each T-shirt costs $5 and your order should specify sizes and quantities desired and be accompanied by full payment (cash or money order payable to "Renee Flack — T-shirts '83").



Mort Rosen

Members of the Physics Department staff recently observed BNL anniversaries. Bottom row, from left: Anthony Meade (20 years), David Cox (20 years), Robert Scheetz (20 years), John Olness (20 years). Top row, from left: Harold Sauter (20 years), Barbara Still (30 years), Ernest Courant (35 years), Paul Levy (30 years), Lloyd Davis (35 years), Ralph Helmig (20 years), and Keith Jones (20 years). Albert Roberts (25 years) was absent when photo was taken.

Softball

Scores for week of July 11

League I

Blue Jays 12 — Phoubars 4

The Blue Jays put the game away in the sixth with seven big runs. G. Oldham, Dennis Hall and Nick Pisco were 3 for 4; Dennis had a bases loaded triple. For the Phoubars, John Ingoglia and Dave Jensen were 3 for 3.

Ravens 28 — Ice Pops 10

For the Ravens, Bob Brown was the big gun with 5 for 5, 2 home runs, one a grand slam. Bob Barone and Harold Bolling were 4 for 5, Eric Brown was 3 for 3 and Leon Lawrence was 2 for 2.

Six Pax 32 — Big Sticks 11

For the Six Pax, Wayne Rambo went 5 for 5. Ralph Brown had 2 home runs and Ed Meier, Jr. had one home run.

AMD 16 — Moles 6

AMD rebounded from the "no-hitter" of the previous week with good defense and a great offense.

League II

Random Errors 22 — Light Source 5

For the second time in two years, the Random Errors won a game.

Magnuts 16 — Lights Out 12
Roga 13 — Medical 7
Dirty Sox 8 — Titans 3

League III

E-Z Riders 15 — No Names 3
Survivors (won) — Nads (lost)
TNT 8 — Mole-Esters 6

League IV

Underalls 8 — Mudville Sluggers 7
Turkeys vs. Who Cares
Game Postponed
Septembers 20 — No Feedback 17
Random Sample 13 — Who's On First 8
The Source 21 — Spacekadets 12

Mountain Club

A meeting will be held on Wednesday, July 27 at 5:30 p.m. at the Brookhaven Center to organize a canoe trip on the Farmington River (Conn.) the weekend of July 29-30, and to discuss plans for August. Anyone who wants to go on the Farmington trip, but can't make the meeting, call Pat Thompson on Ext. 7635.

Arrivals & Departures

Arrivals

Leonard R. Dupuis .... Applied Science
James L. Ivett ..... Medical
Robert M. Sweet ..... Biology
Peter Z. Takacs ..... Instrumentation

Departures

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

Joan E. Caime .....Central Shops

Afro-American Club

The Afro-American Culture Club will sponsor an African Art Show and Sale on Saturday, July 30. Display of the items will be from 2-6 p.m. in Berkner Hall, Room A. The African merchandise will include woven baskets and placemats; tie-dyed napkins, tablecloths, dashikis and caftans; carved napkin rings, ivory and masks, copper, brass and ivory jewelry and original, signed lithographs.

Kids Dive For Loot

The first Pool Special of the season featuring a "penny fetch" took place last Friday afternoon. The contestants were given fifteen minutes to dive in and emerge with coins that were scattered about the bottom of the pool.

The following children received awards in addition to the money they were able to retrieve:

4 & 5 year olds
1st John-David Beuhler
2nd Adam Huhn
3rd Michele Begon, Eric Thern and Janne Vehanen

6 & 7 year olds
1st Jaahho Vehanen
2nd Chris Fox
3rd Debbie Tighe

8 & 9 year olds
1st Keith Chan
2nd Hilda Brink
3rd Kathleen Holden

10+ year olds
1st Alyse Holden
2nd Russ Mills
3rd Maya Wielopolski

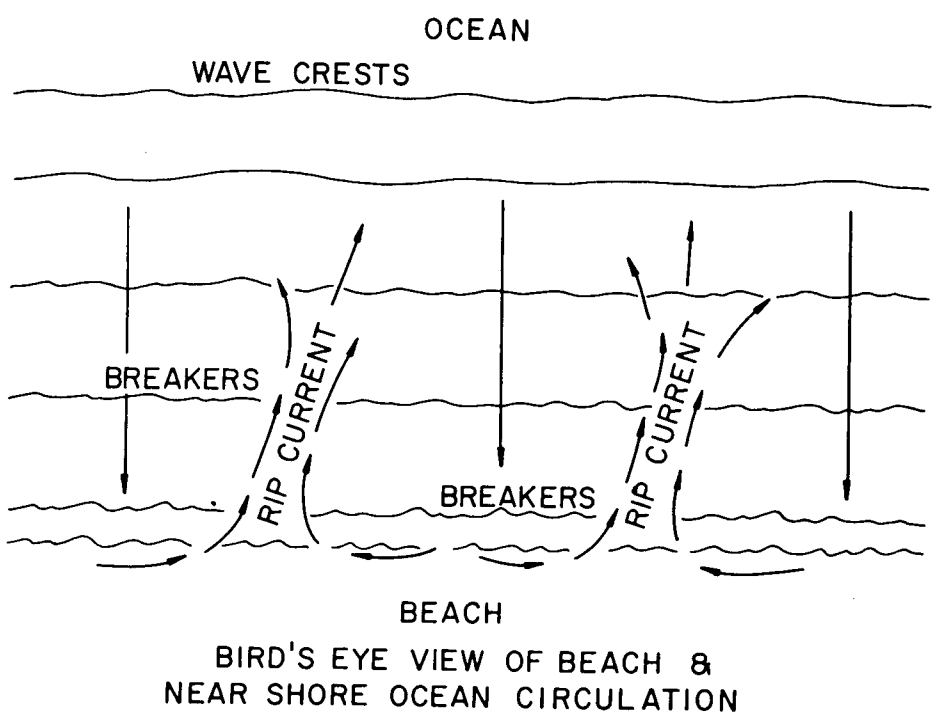
Coming Events:
Today at 3:15 — Kickboard Races
Next Friday — Relay Races

Cafeteria Menu

Week Ending July 29, 1983

Monday, July 25		
Spinach egg drop soup	(cup)	.65
	(bowl)	.75
Broiled chicken livers & onions		1.80
Swedish meatballs on noodles		1.85
Hot Deli: Roast turkey breast	(bread)	1.85
	(roll)	2.00
Tuesday, July 26		
Lentil soup	(cup)	.65
	(bowl)	.75
Cheddar beef steak & 1 veg.		1.85
Southern-fried chicken w/stuffing & cranberry sauce		1.95
Hot Deli: Sandwich steak w/peppers & onions	(bread)	1.95
	(roll)	2.10
Wednesday, July 27		
French onion soup w/croutons	(cup)	.65
	(bowl)	.75
Seafood platter		2.15
Veal scallopini & 1 veg.		1.95
Hot Deli: Chicken breast Parmesan	(bread)	2.05
	(roll)	2.20
Thursday, July 28		
Tomato rice soup	(cup)	.65
	(bowl)	.75
Sauerbraten & potato pancake		2.00
Turkey à la king on rice		1.85
Hot Deli: Sausage & pepper hero		1.95
Friday, July 29		
New England clam chowder	(cup)	.65
	(bowl)	.75
Fish & shrimp Newburg on rice		2.00
Macaroni & cheese w/1 veg.		1.80
Hot Deli: Top round of beef	(bread)	1.95
	(roll)	2.10

Some Tips On The Rips



BIRD'S EYE VIEW OF BEACH & NEAR SHORE OCEAN CIRCULATION

A summer at Brookhaven without excursions to the ocean is like a day without wine. The Great South Beach, so easily reached via William Floyd Parkway and the Smith Point Bridge is one of the most pleasant in the world. It doesn't quite present the perfect wave for surfers, but come July, the water is most inviting. The unshingled beach and open paths in the swale offer tranquil walking or strenuous jogging. It offers splendid solitude or the most frenetic social activity.

For the inlander or newcomer, a word about swimming in the ocean may be appropriate. Heavy surf should be left to strong and experienced swimmers. In moderate surf, diving seaward under the breakers is not only exhilarating, but safer than trying to bob over or to confront them.

On occasion, the surf sets up a circulation resulting in rip currents which can be dangerous. These rips are relatively narrow, high speed currents which return to the ocean the water brought shoreward by the wind and breaking waves. These currents are distinctly different from the so-called undertow which occurs at, and is confined to, the lip of the beach. They are not always easy to detect at sea level and must be treated with respect.

Surfers have come to use rip currents to return quickly out to the line of fresh breakers. However, anyone caught unwittingly in such a current should not try to swim directly to shore, but swim parallel to the beach until out of the current, and then to the beach. Remember also the extra buoyancy of salt water which makes floating a practical means of regaining breath and composure.

For most, the sun proves a greater hazard than the sea. Use of sunscreen lotions (especially on children) and hats, and the consumption of copious supplies of suitable beverages to combat dehydration, will make being at the beach comfortable, as well as safe.

—R.C. Anderson

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: Opportunity for present Laboratory employees.

1907. SECRETARIAL POSITION - Requires excellent secretarial and communication skills. Will assist administrative staff with report and correspondence preparation, travel arrangements and processing of ILR's and PR's on IPAP system. Knowledge of word processing desirable. National Synchrotron Light Source Department.

OPEN RECRUITMENT: Opportunities for present Laboratory employees and outside applicants.

1908. TECHNICAL POSITIONS (2) - Requires AAS degree in electronic technology or equivalent and background in complex electronic and electromechanical equipment, including vacuum systems. Will construct, repair, modify and operate equipment and facilities at the Tandem Van de Graaff Accelerator. Rotating shift work. Physics Department.

1909. TECHNICAL POSITION - Requires AAS degree in electronic/mechanical technology or equivalent and background or experience in: complex electronic systems, vacuum technology, ion, and cryo-pumps, lathes and milling machines etc. Familiarity with microprocessors, lasers and precision optical systems desirable. Will work with the Laser Electron Gamma Source group. Physics Department.

1910. TECHNICAL POSITION - Requires AAS degree in electronic technology or equivalent and substantial experience in analog and digital processing techniques, as well as a thorough knowledge of amplification and transmission techniques needed for processing extremely small/fast analog signals. National Synchrotron Light Source Department.

1911. TECHNICAL POSITION - Requires AAS degree in electronic technology or equivalent, demonstrated experience with high power rf systems, an thorough knowledge of rf construction and measurement techniques, and experience with high voltage power supplies. National Synchrotron Light Source Department.

1912. TECHNICAL POSITION - Requires AAS degree in electronic technology or equivalent experience with high power dc supplies and a thorough knowledge of construction and diagnostic techniques. Experience with microprocessor interfacing is desirable. National Synchrotron Light Source Department.

1913. TECHNICAL POSITION - Requires AAS degree in electronic technology or equivalent experience in digital systems and controls and a thorough knowledge of microprocessor construction and troubleshooting techniques. National Synchrotron Light Source Department.

1914. SCIENTIFIC ASSOCIATE - Requires a BS or equivalent experience in a scientific or engineering discipline. To provide support for the four Chemistry Department beam lines at the National Synchrotron Light Source. Responsible for maintenance and some repair of associated electronic equipment and ultrahigh and high vacuum hardware. Needs ability to work with outside users and to coordinate on-site services. Chemistry Department.

1915. BIOLOGY ASSOCIATE - Requires BS in biochemistry or equivalent experience. To grow bacteria and isolate hestone-protein complexes for structural investigations. Biology Department.

Autos & Auto Supplies

79 CHEVY MONZA - like new, $2,000. 475-8952.

75 HONDA - CB125S, $350. 472-1473.

70 ELDORADO - asking $2,200. F. Thomsen, Ext. 7684 or 584-5933.

76 HONDA MOTORCYCLE - 750cc, reasonable. 363-7032.

TIRES - (2) B60-13 on Ansen Sprint mag wheels. $75/pr. Ext. 4615 or 475-6981.

70 DODGE PICKUP - $950. Angelo, Ext. 3457 or 661-4401.

71 TOYOTA COROLLA - $750. Mike, Ext. 4649 or 732-1722.

TRUCK CAP - 8', $250. Joe Henriques, Ext. 4439

80 HONDA ACCORD - $4,800. 472-1493.

81 CHEVETTE - $3,675. 473-2473.

73 PONTIAC SAFARI WAGON - $800. Frank, Ext. 7200 or Edy, Ext. 3336.

427 CYLINDER HEADS - $150. Ext. 3869.

BUICK CHROME MAGS - (4) $60; 12 bolt Chevy 6 lug rear, $50. Ext. 3869.

74-75 BLAZER TOP - asking $500; 79 quarter panels, $400. 744-3968, leave message.

77 FORD LTD - needs engine work otherwise good cond. J. Allentuck, Ext. 2412.

74 AMC GREMLIN - $500 or best offer. Ext. 7707

63 FORD PICKUP - $700. 924-7489.

8' WINABAGO CAP - for pickup. Richie, 654-0710 eves.

72 CHEVY PICKUP - 289-1568.

81 HONDA ACCORD LX - $7,000. 567-7440 or 472-1182 after 6 p.m.

78 MUSTANG II - $2,800. 567-5593 eves.

72 VW BUS - $1,000. 654-2076.

VW PARTS - brand new. Augie, Ext. 2419 or 289-4211 eves.

73 VW TRANSMISSION - semi-auto., good cond., $90. Toni, Ext. 2907.

79 HONDA MOTORCYCLE - CM400T, $1,000. Ext. 7125.

71 CHRYSLER - $850. Tom, Ext. 4084 or 878-1060.

74 DODGE VAN - $1,000. Gerry or Dionne, 878-1124.

81 TOYOTA CELICA GTA - $8,000. Linda, Ext. 7745.

79 CHEVY CHEVETTE - $2,950. 277-4091.

73 MONTE CARLO - $1,300. Peter, Ext. 4414 or 475-8406.

71 CHEVY IMPALA - asking $850. Scott, Ext. 2582 or 286-8624 after 6 p.m.

72 PICKUP CAMPER - Roadcruiser. 281-6365 after 6 p.m.

78 HONDA CX500 MOTORCYCLE - $1,100. Ext. 2259 or 473-8356 eves.

71 OLDS VISTA CRUISER - 286-1832 after 5 p.m.

68 OLDS DELMONT - $200. Ext. 3558.

81 CHEVY MALIBU CLASSIC - $6,200. Ext. 5294.

75 PLYMOUTH CUSTOM VALIANT - Ext. 4134.

80 CHEVETTE - 732-7444.

77 FORD VAN - Econoline. 325-1014 or 878-2172.

72 TOYOTA MARK II - station wagon, $550. Jack, Ext. 4411 or 929-8287.

77 BUICK LESABRE CUSTOM - $2,500. Ext. 3117.

FULL HUBCAPS - single & sets, 14" & 15" Chevy/15" Dodge, $3/ea. or $11/set. Rino, 273-2958.

69 FORD STATION WAGON. Ext. 4571.

73 PLYMOUTH DUSTER - $650. Ext. 4948 or 924-6104.

79 HONDA MOTORCYCLE - $1,900. Payton, Ext. 2843.

80 HONDA MOTORCYCLE - 650, $1,900. 286-0114 or 286-0273.

70 AMC MATADOR SST - $450. Ted, Ext. 4163 or 286-0065.

69 RAMBLER - $325. Ext. 3082 or 727-1346.

73 GREMLIN - $550. Mike, Ext. 2139 or 289-1488.

Boats & Marine Supplies

GAS TANK - 18 gal., built in. 363-6940 after 5 p.m.

26' SAILBOAT - 8'3" beam, 3'9" draft, diesel power, VHF, D.F., sleeps 5, documented, excel. cond., $18,000. Ext. 3992 or 298-4172.

18' WOODEN HULL - 40 HP Evinrude, Navy top, trailer w/new axel. 941-9442 eves.

6' HARDWOOD OARS - $15. Pete, Ext. 4819.

BOARDING LADDER - 6 step, mahogany, all bronze w/brackets, fittings, $25; Homestrand 2 burner alcohol stove, last model built in stainless steel, $35, or both for $55. 477-0301.

81 TRI HULL FIBERGLASS BOAT - w/65 HP Mercury, C.B., bilge pump & many extras, asking $2,200. 399-4122.

7' OPTIMIST - class sailing pram, excel. cond. 298-8657.

20' O'DAY - sleeps 4, trailer, outboard, loaded, excel. cond. 286-0259.

Yard Sales

JAMESPORT - Sat., July 23, Manor Lane, first left past Elbow Room Restaurant. Linda, Ext. 7745.

BELLPORT - July 22, 23 & 24, 9:00-5:00, Lester piano, $800, 13 Bieselin Rd., 286-8452.

Miscellaneous

WINDOWS - used, doors, screens, storms, various sizes; (2) guitars, make an offer. Andy, Ext. 2424.

DRAPES - triple width, 3 pr., royal blue, cleaned & pressed, $50. 654-4609.

CASSETTE RECORDER - Panasonic, RQ-409S, built in mike & handle, excel. cond, $30. Ext. 3876 or 4822.

COUCH - 101", green & beige floral, 3 seat & back cushions, good cond., $100. Ext. 4183.

RUGS - (3) 28"x39", 22"x30", 43"x66", spring green; Clairol lighted make-up mirror, like new. 924-0565.

STONE GRINDER - antique commercial, motorized. Ext. 3688 or 363-7032.

LAWN MOWER - Craftsman, 22" self propelled, electric starter w/bag, 2 mo. old, cost $400, sell $200. 281-8274.

TWIN BED - $40; two-seat sofa, $5; stereo cabinet, $20. 924-0318 after 6 p.m.

ELECTRIC STOVE - G.E., four burner, oven & broiler; 30", gold, $160. Mike, 654-1186 after 6 p.m.

ROYAL TYPEWRITER - Ext. 3688 or 363-7032.

REFRIGERATOR - & dryer, run well, $25 ea. or both for $40. Ext. 4664 or 744-8779.

VACUUM CLEANER - $20; high chair, $20; & more children's items. 924-0318 after 6 p.m.

MOWER - needs valves ground, has new 24" blade & carburetor fixed, $10. Mike, Ext. 3867.

POOL LADDER - A-frame, 6', $10; 12' pool slide, needs pipes, $10; 36x54 cotton Amer. flag, $5. 878-6637.

SEARS SAW - 10" radial arm w/attach., $275; wood coal stove w/pipe, used 1 season, $250. Ext. 3457.

SLIDING GLASS DOORS - 36"x78", $10; beautiful oil paintings, sacrifice, $10-$30; two palm plants. Irene, 589-5126.

CRIB - heavy, sturdy, $25; Strolee car seat, $10; platform rocker, maple trim, upholstered, clean, $25. 878-6637.

SECTIONAL COUCH - 7 pc., brown & beige, $125. Ext. 2673 or 744-8632 after 6 p.m.

FORMICA COFFEE TABLE - rectangular, good cond., $30. 589-4218.

COOKING GRILL - electric Char-B-que, w/deluxe redwood cart, $100 value, sell for $40. Walt, Ext. 7154.

AIR CONDITIONER - 8000 BTU, Sears best, 110 VAC, used twice, orig. $430, asking $215. 744-0584 after 6 p.m.

CANNING JARS - glass top, quarts; Panasonic portable 8-track player. Ext. 2950.

BLANK CASSETTES - BASF, CrO2, C-90, $2.75 ea. Ext. 2521.

CHILD'S SEATS - for adult bike, (2), 50 lbs. cap., seat belt, excel. cond., $25 ea. Ken, Ext. 4461.

FREEZER - 12 cu. ft., excel. cond.; baby dressing table, wicker w/3 drawers; large blue & white bathroom vanity. 298-4398.

RECORD PLAYER - old Victrola, wind up, table model. Brownie, 725-1495 after 12 noon.

COMPASS - Danforth Express, $85; hard suitcase, 8"x20"x28", $10. Ext. 4058 or 286-0436.

GENERATOR - ONAN, large, about 10KW, needs motor overhaul, $80 as is. Ext. 4058 or 286-0436.

LAWN ORNAMENT - hand made wood chopper, 27" long, $10. Pete, Ext. 4819.

TRESSEL TABLE - 2 leaves w/6 chairs & pads, $400; antique furniture table, buffet, china closet, $100; dishwasher, $100. Liz, 281-6488.

DEEP WELL PUMP - 1 HP, 42 gal., glass lined tank, $125. Henck, 281-5626.

HAMS - Heath C.W. tranceiver HW16, w/V.F.O., ant. tuner, SWR meter, coax, switch, complete, $200. 589-2648.

ANTIQUE SPINDLE-BACK ROCKER - oak w/carvings, $75; antique trunk w/brass fittings, $45; both in great shape. 475-2090 eves.

POOL FILTER - 1/2 HP, D.E. Hayward, used 1 season, $200; vacuum, skimmer, ladder, winter cover, etc., $300 takes all. 929-6692.

CLUB CHAIR - gold, $125. 281-6026.

ELECTRIC GUITAR - & amplifier, like new, $400. 277-4091.

WOOD & COAL STOVE - good cond., asking $50. 399-4122.

3-WHEEL BIKE - Sears, 3-spd., w/basket, excel. cond., asking $175. Thelma, 281-7720.

COLONIAL BUFFET - & hutch, less than 1 yr. old, $300 firm; kitchen set, butcher block, table w/4 cane chairs, asking $200; professional pool stick w/case, brand new, $20. 399-4122.

LADIES BICYCLE - 10 spd., 28" frame, like new, $90. 473-3938.

LOCAL WILD FLOWER HONEY - new crop, unfiltered, unheated, $1.75 lb., will deliver. George, 744-3289.

RAILINGS - (2) for a 3-step stoop, heavy duty wrought iron, like new. Jim, 744-3792.

SEMI-SHAG RUG - 12'x16', rust, very good cond., $150. 234-1154 eves.

SINK - double-basin, double-drainboard, white porcelain on cast iron, $10. 744-5096 after 6 p.m.

RACER - Ross Apollo, 20", $30; 3-wheel ladies bike, $85; lawnmowever, 21", $30. Dick, Ext. 3499 or 589-9103.

DISHWASHER - full size, portable; refrigerator, free for the taking. 821-0766.

DINING ROOM SET - contemp., 6 chairs, table w/2 leafs, china cabinet, must sell. 758-6879 after 5 p.m.

PICTURE WINDOW - 3'9"x8'9" aluminum, triple track, includes screens, storms, & frames, aluminum & wood, $50. Lew, Ext. 5193.

COLOR TV - Sylvania, 19", needs some work, $35. O. Booker, Ext. 3082 or 727-5912.

STOVE - G.E., electric, yellow, good cond., $100. Ed, Ext. 2477.

WATER SKIIS - Cypress Garden Official, hardwood, excel., $75; Lomart stainless steel pool filter (in-ground), new parts, $65. 878-1804.

SOFA - 90", contemp., frame & cushions in good cond., needs recovering, $35. Fran, Ext. 3379 or 589-3485.

ELECTRIC TYPEWRITER - Smith-Corona, practically new, reasonable; Quartz Radiant heater, excel for saving energy, reasonable; (2) tennis rackets, very reasonable. Ext. 4886.

TELEPHONE - desk-top model, record-o-phone, $5. 282-3074.

TV ANTENNA - Radio Shack V-185, brand new, $50. 744-9672.

BMX BIKE - Diamond-back, excel. cond. Glenn, 928-3545.

UPRIGHT PIANO - $550; desk, $85; sofa, $50; reclining chair, $60; (2) wardrobes, $10/ea.; Zenith green computer monitor, 12", $100. Maria, 751-2709.

POOL TABLE - slate, regulation size, all accessories, like new, $175. Ext. 7502 or 265-3208.

TRUCK WINCH - hand operated, 5/10 ton capacity, takes 80 ft. plus of wire, rope. Rino, 273-2958.

DANISH CHAIRS - (4) $20/ea.; dining room table (40x60), $25; hi-fi cabinet, mahogoney + speaker, $35; Emerson air conditioner, 8,000 BTU, good cond., $125. 265-0501 after 6 p.m.

PINE CORNER HUTCH - Bennington, $275; pine table, $45. 698-2202.

DINING ROOM SET - Parkay table, 6 highback wrought iron chairs, excel. cond., $300. 281-0350.

EMERSON AIR CONDITIONER - 8,000 BTU, good cond., $125. 265-0501.

Car Pools

COMMACK - on time, 8:30-5:00, door to door. Jim, Ext. 4452.

HUNTINGTION STATION/MELVILLE - 4th driver needed. Meyer, Ext. 3036.

Free

WHITE CAT - nice & fresh; cedar shingle scrap wood, good for fireplace. 744-3792.

CLAM BOAT - 20 ft., as is, you remove. 286-8521.

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

SAYVILLE - cedar & brick ranch, 7 rm., eik, d/r, 2 full baths, full basement, garage, central air, extras, excel. cond., can be made mother/daughter apt., $69,900. 589-2681.

BROOKHAVEN HAMLET - custom 4 bdrms., 1.25 acres, 2-car attached garage, walk to schools, 9 mi. to Lab, 1 mi. to bay, excel. cond., privacy plus room to expand, asking $125,000. Ext. 4058 or 286-0436.

MARGARETVILLE, NY - year round, 2+ bdrms., 2 baths, elec. & wood heat, full cellar, fireplace, 2 car garage with shop & loft, all heated & insulated storage bldg., 8 acres, 2 cleared, 1/2 stream, adjoins state land. 914-586-4634.

RIDGE - (1) acre bldg. plot, fully wooded in quiet established neighborhood, $13,500. 924-3236.

SHIRLEY VICINITY - 3 bdrm. ranch, full basement w/garage, 7 yrs. old, walk to beaches & stores, asking $46,000. Ext. 4547 or 399-4122.

WEST SAYVILLE - 3-1/2 bdrm., split level, dining rm., den, enclosed porch, 1/4 acre, quiet street, Sayville school district, asking $69,000. Frances Brown, 589-3485 eves/weekends.

For Rent

N. SHIRLEY - modern 1 bdrm. apt., 5 min. from Lab, beautiful fenced yard, security/refs., $400 + util. 281-05605, 6-8 p.m.

DELRAY, FLORIDA - new oceanfront condo, fully equipped, sleeps 6, 2 baths, avail. 1 week starting 12/3, salt & fresh water pools, shuffleboard, tennis, putting green, $750. Stang, 13769 Exotica Lane, West Palm Beach, 33414.

BELLPORT VILLAGE SOUTH - near bay, stores, fully furnished, spacious, modern house including all appliances & piano, late Aug. to X'mas or January, rent negotiable to responsible tenant. 286-0379.

EASTHAM, CAPE COD - 4 bdrm. house, sleeps 8, 2 baths, washer & dryer, dishwasher, deck, near beaches, lower rates for fall. 722-3865 eves/weekends.

MILLER PLACE - 2 story, colonial, 8 rms, 4 bdrms, 2 car garage, ½ acre, 90-180 days, immed. occupancy. $850/mo. Ext. 7532.

Wanted

EXERCYCLE - or similar which includes arm exercise capability. Ext. 4892.

SUNFISH - in good cond., reasonable priced. 286-1097.

BMX BIKE - good model w/hand brake, inexpensive. 286-3742.

WASHING MACHINE - in good cond. 298-4398.

HOUSE TO SIT - caring, experienced, responsible, no charge, August only. J. Allentuck, Ext. 2412.

HOUSEMATE - to share large house, 20 min. to Lab, sundeck, washer, dryer, dishwasher, $164/mo. & 1/3 util. Ext. 2521 or 928-8379.

TRAINS - Lionel, American Flyer, access., any cond., brings good price. Carole, EXt. 3362 or 924-4097 eves.

HOUSEKEEPER - f/t or p/t, care for home & children. Ext. 3665 or 744-4611 after 7 p.m.

CHEVY WAGON - 9 passenger, 1975 or 1976. Liz, Ext. 2082 or 286-8563.

MEN'S WATCHES - Bulova, Accutron; electric snow blower. George Hrabak, Ext. 3536.

TO RENT - house or apt. for couple during August, 1983. Ext. 4192.

AUTO BODY WORK - need someone to sand & prime car at moderate cost. Ext. 4192.

ROOMMATE - to share 3 bdrm. house in Shirley, no children, references.399-4122.

HOME - for loving 2 yr. old male Lab/Shep. Ext. 3946 or 878-9471.

GOLF CART - hand drawn. 581-7656.

HOUSE TO RENT - 3-4 bdrm., 1 yr., Stony Brook, Port Jeff area. Tony, Ext. 2387 or 246-9251 eves.

Ads for Services may be posted at the BERA Sales office.

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