BROOKHAVEN BULLETIN
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BROOKHAVEN NATIONAL LABORATORY

# Introduction to Astrophysics at BNL

## The Origin Of Elements

Everything in our world is formed from elements, but where do those elements come from? As astrophysicist Ken'ichi Nomoto says, "For the origin of the elements we should investigate the history of the universe."

As Nomoto, who is visiting BNL this year from the University of Tokyo, recounts that history, it begins with the tremendous explosion called the Big Bang, in which the contents of the universe were spewed forth, in the form of hydrogen (H) and helium (He), from an incredibly dense core of matter. Afterwards, the universe was too cool to synthesize elements other than H and He — until stars formed from the interstellar gases.

As gravity causes a star to contract, temperatures rise and the stellar interior is converted into a fusion reactor:

- At about ten million degrees, the lightest elements begin to fuse; groups of four H atoms combine to form one He. The star's center becomes almost pure He.
- Around 100 million degrees, three He nuclei fuse to form one carbon nucleus. Almost simultaneously, oxygen is formed when a carbon captures one alpha particle.
- Between 500 million and three billion degrees, other fusion reactions create such elements as neon, magnesium, silicon and calcium.
- By six billion degrees, the core is reduced to a dense mass of iron, which cannot produce further energy by fusion. With the core supported only by pressure from its electrons, a supernova explosion is imminent.

Not all stars become supernovae. Our sun, for example, which is presently almost stationary in structure, will start to expand after another five billion years. Eventually, its surface will engulf the Earth and extend to the orbit of Mars. Then, the expanding part, the nebula, will be detached from the inner core. In such a case, Nomoto explains, "Inside the nebula, a very tiny stellar object is left, about the size of earth but about one million times as dense, about one-half the weight of the sun. This is called a white dwarf, because the core that's left is quite hot and emits a blue white color, but it's very small."

An isolated white dwarf is peaceful, but when it is one half of a stellar pair called a binary, accretion of gases from the companion star can cause the white dwarf to explode. This is a carbon deflagration and might be termed a "carbon bomb."

Supernova explosions, says Nomoto, explain many of the heavy-element abundances in the universe. The currently favored theory, he explains, is that the heavier elements, such as iron, nickel and manganese, are formed in the explosions of white dwarfs, while the lighter elements — oxygen, magnesium, neon, etc. — are the result of supernova explosions of very massive stars, perhaps 20 times larger than the sun. The intermediate elements, such as calcium, sulfur and silicon, may come from both sources, as well as from explosions of stars of in-between sizes.

Though Nomoto calls the stars "a very good laboratory for studying element origin," they are also a laboratory to which no one can ever go. So how can Nomoto and other astrophysicists know so much about the temperatures and elements in stars?

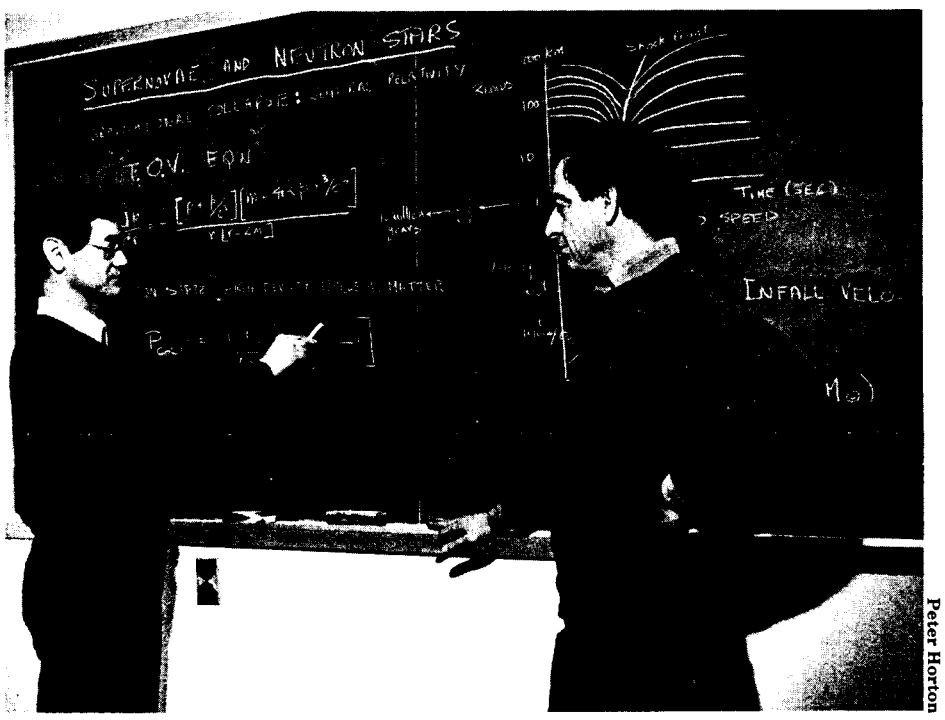
*At the end of a long day, it's often comforting to look up at the starry nighttime sky: so peaceful, so immutable, so constant.*

*That's a nice illusion, but the fact is, the only thing constant about the stars is that they are constantly changing. And the changes are often far from peaceful. A growing number of physicists at Brookhaven are studying some of those changes as they conduct investigations in theoretical astrophysics.*

*A primary motivation for this work is that it may explain the abundance of important heavy elements in our universe — an abundance that accounts for our very existence. Stars are the result of gravitational attraction, which draws atoms out of the gaseous clouds of hydrogen (H) and helium (He) that populate the universe, forming a stellar mass. Over time, gravity continues to attract the H and He atoms, contracting them into an ever hotter, more compact mass. As temperatures increase, fusion reactions take place, forming new elements.*

*If the star's mass is, say, ten to twenty times more than that of our sun, it may eventually become a supernova. This very violent, very bright stellar explosion serves to disperse heavy elements into the universe.*

*In the Physics Department, Sidney Kahana has been working with astrophysicists from the State University of New York at Stony Brook since 1979, evolving scenarios for what happens to a supernova in those last milliseconds. With funding from the Laboratory's Exploratory Research Program, Kahana has been joined for this fiscal year by Ken'ichi Nomoto, an astrophysicist from the University of Tokyo, who focuses more on the synthesis of elements that takes place over millions of years, as a star evolves to a supernova.*




Peter Horton

**Engaged in a discussion about their research in astrophysics are (from left) Ken'ichi Nomoto and Sidney Kahana.**

As Nomoto explains it, "Astrophysics is an interface between several fields. First, we must be in close contact with nuclear physicists, who give us nuclear data from reaction experiments, which tell us at what temperatures different nuclei undergo reactions. We use nuclear reaction rates to simulate the nuclear synthesis in stars with supercomputers. And this is not just speculation. From astronomical observations, we have good evidence that the synthesis of heavy elements our computer models predict actually takes place."

Some of this evidence comes from observing the light spectrum from an actual supernova, through an optical telescope. The star's ultraviolet radiation can also indicate the presence of synthesized elements and can be observed using such devices as the International Ultraviolet Explorer (IUE) satellite.

Nomoto first visited the U.S. in 1980, working at NASA's Goddard Space Flight Center in Maryland. His colleagues at Goddard used the satellite to observe the Crab Nebula and measure the amount of carbon in it.

The Crab Nebula is the halo-like

(Continued on page 2)

**The arrow points to a Type I supernova observed in 1981 in the galaxy NGC 4536. This single object is as bright as the entire galaxy. Most of our present knowledge of actual supernova explosions comes from such viewing of distant galaxies.**

## Understanding Supernovae

If some stars did not make the transition from contracting stellar masses to exploding supernovae, our universe would be bereft of much of the heavy elements that contribute to life on Earth. But why do some stars become supernovae while others do not?

That's a question Sidney Kahana began to ask around 1979, at the urging of Gerald Brown, a professor at the State University of New York (SUNY) at Stony Brook. Kahana, a nuclear and high energy physicist who leads the Nuclear Theory Group in BNL's Physics Department, also had an interest in astrophysics. As the Laboratory had no program of this type, Kahana has been working with astrophysicists in the Physics Department at SUNY at Stony Brook.

Kahana and his colleagues, Ed Baron and Jerry Cooperstein, are interested in the specific mechanism for the catastrophic end to a star's life. Theory holds that, after some ten million years, when the star has been compressed by gravity and has consumed all the nuclear fuel in its core, it collapses under gravitational forces. This catastrophe compresses the nuclear matter in the collapsing core to extreme densities, and the inner core matter begins to stiffen.

At this point, the core is only several tens of kilometers across, but so dense that a teaspoon of it would weigh about ten billion tons. Around the core are a mantle and an envelope, which consist of the elements created in earlier stages. Inevitably, a shock forms between the stiffening inner core and the still collapsing outer core. If the shock is not strong enough, the star will become a black hole (a dense concentration of matter). But if the shock is energetic enough, it will go beyond the core, promptly ejecting the mantle and envelope.

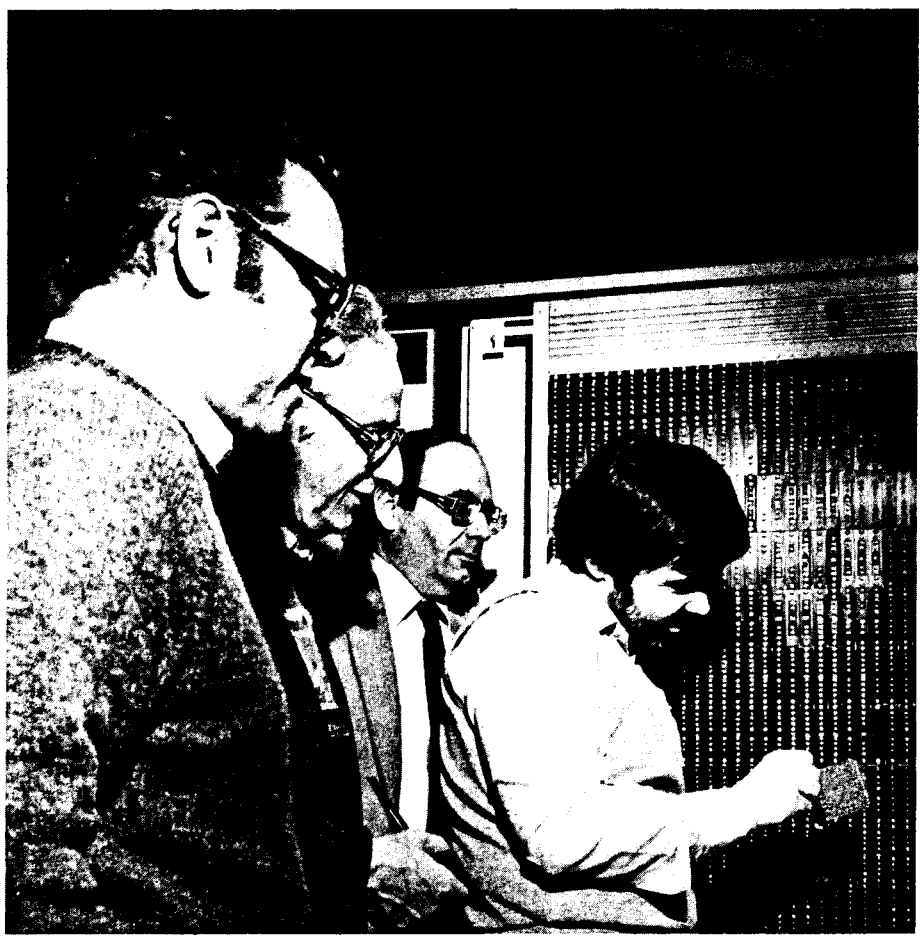
What determines whether the shock will have sufficient energy to get out? To find out, around 1979, several different groups worldwide created computer models of the hydrodynamical evolution of stars during collapse.

None of the groups could explode a supernova. As Kahana says of his earlier efforts with Cooperstein and Thaddeus Mazurek, also of SUNY at Stony Brook, "Given our best knowledge at the time, we could not explode a star in our range of study — 12 to 25 solar masses [our sun is one solar mass]. The shock ended up just sitting there. We would have ended up with a black hole."

So Kahana tried again in 1982 and 1983, this time working with Cooperstein and Baron. "The first thing we did," Kahana says, "was to soften the nuclear equation of state, a mathematical expression that defines the physical state of the star." Softening the equation means the theorists changed some of its parameters. "We did not succeed in exploding the star by softening the equation of state," Kahana says, "but the shock got stronger."

Encouraged, the theorists tried a more exotic approach: introducing general relativity into the model. Einstein's theory predicts, among other things, a strengthening of gravity. "We don't see non-Newtonian effects here on Earth," Kahana explains, "but we thought they could be crucial. And, indeed, it increased the intensity

(Continued on page 2)



Peter Horton

**In February 1966, when the Applied Mathematics Department (AMD) moved into new quarters in Bldg. 515, it also accepted delivery of a new computer system: the Control Data Corporation (CDC) 6600, the most powerful computer then in existence. Last year, AMD installed four new computers in the Central Scientific Computing Facility (CSCF), known collectively as a VAX cluster, to take over most of the aging CDC 6600s' duties. By January 1986, a CDC 830 had assumed all the remaining functions of the 6600s. So, at 5 p.m. on Friday, February 14, almost 20 years after the CDC 6600s started up, Mike Losquadro shut them down, by removing the "heart," the module that provides the signal to which the rest of the system is timed. Removing the heart effectively retires the system. Losquadro, who heads AMD's hardware group, was joined in what some called the "Valentine's Day Massacre," by (from left) AMD Senior Project Engineer Clarence Pittenger, who, as a CDC engineer, delivered the system in 1966; John Denes, manager of ADP Acquisitions, who originally accepted the computer for BNL; and Arnold Peskin, AMD's deputy chairman. As the system was relegated to the ranks of excess property, those who had worked with it over the years joined in what Les Lawrence, deputy head of the CSCF, called "a logical celebration." Reflecting on the CDC 6600s' role at BNL, Department Chairman Ron Peierls said, "An enormous amount of good science was done using these machines, and we hope the same will be true of their successors."**

## Coming Up

**Abram Chayes, Felix Frankfurter Professor of Law at Harvard University will give a Lab-wide colloquium at Berkner Hall, on March 7, at 3:30 p.m. He will talk on "The Legal Aspects of the Strategic Defense Initiative."**

## Inside Info

Three Brookhaven physicists have been elected Fellows of the American Physical Society. They are: **Michael Creutz**, who was cited for "original theoretical contributions to the understanding of quark confinement and for the introduction of Monte Carlo methods into quantum field theory;" **Claudio Rebbi**, for "outstanding contributions to theoretical physics, especially the theory of the relativistic string, fundamental properties of non-Abelian gauge theories, and applications of Monte carlo methods to quantum field theory;" and **Andrew Sandorfi**, for "instigating and performing the definitive studies of the radiative capture of light heavy nuclei and for leading a highly innovative proposal for a 100-700 MeV monoenergetic polarized gamma-ray facility."

**It's a fact:** While it seems that most Long Island acreage has been developed, the L.I. Farm Bureau says that 13,000 acres are still devoted to potato-growing; nearly 4,500 acres are planted with nursery products; sod is grown on some 4,000 Suffolk acres; more than 1,000 acres are planted with vineyards.

## On Technical Text

A "town meeting" on the subject of technical text — what we are doing, where we are going and how we are going to get there — will be held at 1 p.m. in Berkner Hall, Room, B, on Tuesday, February 25. The meeting will consist of several presentations by members of a panel of users, producers and managers, followed by an open discussion period. The Applied Mathematics Department, Photography and Graphic Arts Division and the Technical Information Division are co-sponsors. The purpose of the meeting is to familiarize authors, editors and document producers with current trends and problems relating to handling of technical text materials in non-traditional, chiefly electronic, ways. For further information, contact Ron Peierls, Ext. 4104.

## Patent Awarded

U.S. Patent #4,512,025 was issued to **Robert S. Frankel**, AGS, and **Alexander Herman**, a former BNL employee, for developing a baseband digital communication network system with collision prevention. Their system can handle two or more communications simultaneously over a transmission link such as a coaxial cable.

A carrier wave is transmitted over the transmission link and serves at a data station coupled with the link to segregate both transmitted and received signals into at least two separate bands. Thus, at least two simultaneous signal channels may be used in the network without collision.

## Supernovae (Cont'd)

of the shock by a factor of ten."

Though the combination of new physics made their theory successful on the supercomputer, Kahana says, "We could still be wrong, but if we are it's a very big puzzle."

Verification of at least the equation of state may be possible in accelerators in which experiments can be done with heavy ions. In this regard, Kahana is looking forward to the time when the Alternating Gradient Synchrotron (AGS) will begin to accelerate heavy ions from the Tandem Van de Graaff accelerator. "The AGS will, we hope, look at this carefully and consistently. Beyond that, there's the relativistic heavy ion collider proposed for the Lab."

Though Kahana can't visit a supernova to prove his theoretical calculations, he hopes he can witness one. "The only candidate for a supernova in our lifetime," he says, "is Betelgeuse, the shoulder star in the constellation Orion. We say that because it's very likely that its color has changed since the Chinese began watching it, maybe 3,000 years ago. It could explode in the next 10,000 years, or it could have exploded at least 780 years ago. I hope the latter is the case because it would give me a chance to see it in my lifetime."

What would he see? "A supernova is one of the most explosive, catastrophic events possible in our galaxy. Even 800 light years away, you would see it in the daytime. However, if Orion were below the horizon [in summer], I'd have to go to the southern hemisphere to see it."

Though Kahana's focus has mainly been on more massive supernovae, he and his SUNY colleagues are now working with visiting astrophysicist Ken'ichi Nomoto on models of stars of nine solar masses, like the one Nomoto believes was the progenitor for the Crab Nebula (see accompanying story). As with their model of more massive stars, Kahana's hope is that they will see a supernova explosion result from their computerized calculations.

From April to August, astrophysicist Masaaki Hashimoto, University of Tokyo, will join BNL's small astrophysics group, also under the auspices of the Exploratory Research Program. Possibly, says Kahana, "Our team this year will be the precursor to a permanent theoretical astrophysics group at Brookhaven." A strong possibility, he says, is to propose a joint program between BNL and SUNY at Stony Brook.

Though Kahana's main interest remains high energy physics, he would still participate in an astrophysics program. As he says, "It's good to change your point of view in physics because it keeps you young and keeps you learning." — Anita Cohen

## Elements (Cont'd)

remnant of a supernova explosion recorded by the Chinese in 1054 A.D. The IUE showed no abundance of carbon in the Crab. This seemed strange since, at that time, people believed massive stars should produce heavier elements, such as carbon. However, Nomoto had found an exceptional case in his theoretical calculations; in stars of about nine solar masses (our sun is one solar mass), the carbon is not ejected but falls into the core. Today, Nomoto's theory would be fully accepted as the explanation for the progenitor of the Crab Nebula, if only such a star will explode theoretically (see accompanying story).

There's still no explanation, however, as to the exact origin of carbon. "Our theory suggests that carbon is probably produced from small mass stars like the sun, peacefully, during a long-time evolution," Nomoto says, "but this is a still a relatively qualitative argument, not yet quantitatively proved."

Determining the origin of the carbon in our universe, then, is one of Nomoto's present occupations, as is studying Type I supernovae (formed from smaller, older stars) and white dwarfs.

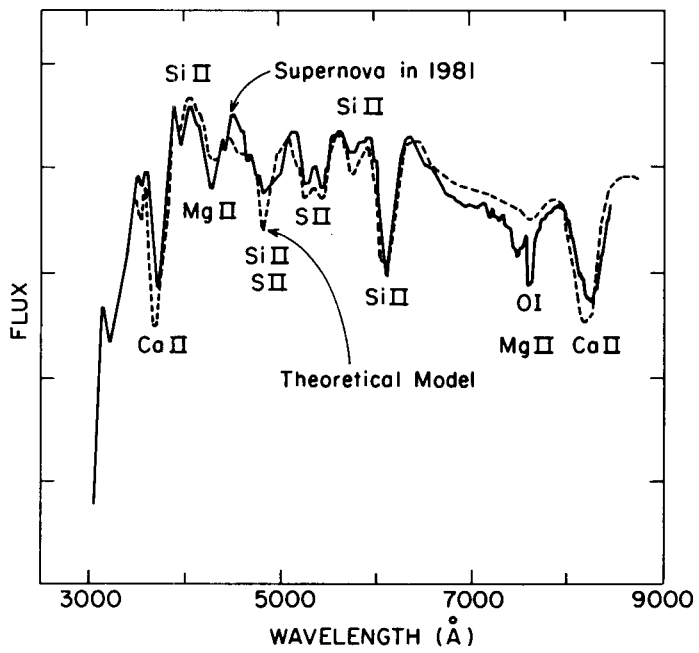
Nomoto looks to the skies for recreation too. "One thing I enjoy here at BNL is the darkness of the sky to observe Halley's Comet," he says. "I couldn't see it at all in Tokyo, but this place is fairly isolated, and that's quite nice, from the point of view of seeing the comet." — Anita Cohen

## WIS Meeting

Associate Biologist Avril Woodhead will be the guest speaker at the next luncheon meeting of Brookhaven Women in Science, on Tuesday, February 25, at noon, in Room A, Berkner Hall. She will give a talk on "UV and Skin Cancer — A Fish Story."

Woodhead has focused her research on the comparative aspects of aging in different species and has organized several symposia at BNL on that topic. She also is studying the behavior of fish in their natural environment and is working with Associate Director for Life Sciences Richard Setlow on DNA repair mechanisms.

The Laboratory community is invited to attend. Bring your lunch.




**How well some of Ken'ichi Nomoto's theoretical calculations agree with actual observation is shown in this graph. Broken line: Theoretical spectrum emitted from newly synthesized elements in the white dwarf model for Type 1 supernovae (formed from smaller, older stars). Solid line: Actual spectrum of the supernova (see photo) as observed through an optical telescope in 1981.**

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## Addled Addresses

It seems that the variations on this theme are endless. Herewith, the latest addresses culled from mail sent to the Lab:

Brookhaven National Lakes
Brookhaven National Laboratory
Not Available
Upton, New York
Brookhare Nat Lab
Broodhaven National Laboratory
Brookhaven Natural Lab
L. M. Laboratory
Upton, New York
National Laboratories
Bldg. 120 Burkhaven
Brookhaven National Lab
Accelerator Lib
Brookhaven National Labor
Bert Caven Nat'l Lab
Brookhaven L. Aborato
National Train Lab
Brockhaven National Lab
City Hall
Upton, New York
Brookhaven Nassau Lab
Brookave National Cab
Brookhaven Nalt Labor
Brookhaven Nation Lab

## Generator Notice

Generator options may be ordered on Tuesday, February 25, and Thursday, February 27, from 5-7 p.m. both days, in the Snyder Seminar Room, Bldg. 911. Be sure to pick up order forms ahead of time at the BERA Sales Office in Berkner Hall. Prices and method of payment are specified in the forms. The options are: a muffler, a multi-fuel operation kit, an electric start kit, an extended run oil kit and an auxiliary fuel tank.

## Quit Smoking Openings

Openings still exist in the American Lung Association stop-smoking workshop being held on-site. Employees or family members of employees who wish to participate in the six-session Freedom from Smoking workshop should come to the first session on Tuesday, February 25, at 5:15 to 6:30 p.m. in Berkner Hall. The dates of the five remaining sessions are: Tuesday, March 4; Tuesday, March 11; Thursday, March 13; Tuesday, March 18; and Tuesday, March 25. By the third session, smokers are expected to be off cigarettes, and staying off cigarettes will be the focus of the remaining sessions. The cost of the workshop for participants is $10, to be paid in checks made out to the American Lung Association of Nassau-Suffolk; to encourage healthier living, the Laboratory will pay the balance of $25 per person.

## Equipment Demo

On Thursday, February 27, from 10:30 a.m. to 2:30 p.m., representatives from Pioneer-Standard Electronics will exhibit Motorola and VME systems at Berkner Hall. In particular, they will show the System 1000, featuring a Motorola 68020 CPU, 2 Mb of RAM, a 70 Mb hard disk, a UNIX V/68 operating system and an IBM PC with a MC68000 CPU card running UNIX V/68. Information on the VME bus and related products will be provided.

For more information and to request other products to be demonstrated, call Seth Bardash or Jim Aita at (516) 921-8700.

## Pick a Student

Completed applications for the 1986 Summer Student Program will be available for review in the second floor conference room, Bldg. 460, from February 24 to March 7.

Guidelines regarding the selection of students have been distributed to research department offices. If interested, please contact your department coordinator. Summer students will be in residence from June 2 through August 15.

## CREF Values

| | | | |
|---|---|---|---|
| February | 72.38 | March | 72.35 |
| April | 71.97 | May | 75.52 |
| June | 76.40 | July | 76.69 |
| August | 75.94 | September | 73.77 |
| October | 77.12 | November | 82.20 |
| December | 85.78 | | |

**January $86.50**

## Note to Diners

The cafeteria will be closed on Saturday, February 22. On that day, snack bar service will be available from 9 a.m. until 2 p.m. at the Brookhaven Center.

## Cafeteria Menu

### Week of February 24

**Monday, February 24**

| | | |
|---|---|---|
| Cream of mushroom soup | (cup) | .65 |
| | (bowl) | .85 |
| Beef stroganoff over noodles | | 2.45 |
| Ham and noodles au gratin w/choice of 1 veg. | | 2.45 |
| Hot Deli: Monte Cristo | | 2.45 |

**To commemorate Black History Month, the cafeteria will present a special buffet every Monday in February.**

**Tuesday, February 25**

| | | |
|---|---|---|
| Chicken rice soup | (cup) | .65 |
| | (bowl) | .85 |
| Veal Parmesan w/choice of 1 veg. | | 2.50 |
| Stir fried Mandarin chicken w/yellow rice | | 2.45 |
| Hot Deli: Smoked turkey breast | (bread) | 2.35 |
| | (roll) | 2.50 |

**Wednesday, February 26**

| | | |
|---|---|---|
| Pork and cabbage soup | (cup) | .65 |
| | (bowl) | .85 |
| Spaghetti and meatballs w/garlic bread | | 2.45 |
| Eggplant Parmesan w/choice of garlic bread or roll | | 2.45 |
| Hot Deli: Baked ham | (bread) | 2.35 |
| | (roll) | 2.45 |

**Thursday, February 27**

| | | |
|---|---|---|
| Corn chowder | (cup) | .65 |
| | (bowl) | .85 |
| Sweet and sour pork w/choice of 1 veg. | | 2.45 |
| Spanish macaroni w/choice of 1 veg. | | 2.45 |
| Hot Deli: Fresh ham | (bread) | 2.35 |
| | (roll) | 2.45 |

**Friday, February 28**

| | | |
|---|---|---|
| Cream of broccoli soup | (cup) | .65 |
| | (bowl) | .85 |
| Prime ribs of beef w/choice of 1 veg. | | 2.95 |
| Hot Deli: 4 oz. steak sandwich | (bread) | 2.45 |
| | (roll) | 2.60 |

**Out of 350 names, the cafeteria manager drew the name of Eduardo Duek, Chemistry Department, as the winner of the Valentine's Day box of chocolates.**

**In concert: (from left) Elisabeth Palmedo, John Lessard, George Fisher and Stephen Payson.**

## Concert Next Week

On Friday, February 28, well-known local musicians will present a collage of musical selections at Berkner Hall, beginning at 8 p.m.

John Lessard, professor of composition at the State University of New York at Stony Brook, conceived and organized the program, which is built around pieces drawn from different cultures.

The program will include the world premiere of Lessard's composition, "The Pond in a Bowl," with text by an early Chinese poet, performed by soprano Elisabeth Palmedo, percussionist Stephen Payson and pianist George Fisher. Palmedo and Fisher will also do a group of songs by Gabriel Fauré, the noted French composer. Classical music of northern India will be represented by a Tobla solo played by Stephen Payson. Finally, the Collegium Musicum of Stony Brook, under the direction of Eva Linfield, will perform a group of early seventeenth century dances as well as the "Veni Dilecti Mi" of Heinrich Schütz.

Tickets are $5 and will be available at the door.

## Afro-American Culture Club

The members of the Afro-American Culture Club mourn the death of their founder and friend Dwight Cameron Brown, who worked in Personnel from 1980-82. Brown died on Wednesday, February 2, at the Truman Medical Center in Kansas City, Missouri, after a long illness. He was 38 years old. We will miss him dearly.

## Bowling

**Scotch Doubles Tournament**

A fun-filled afternoon is guaranteed to those bowling in the annual Tournament being held Sunday, March 2, at 2 p.m. at Port Jeff Bowl. The cost is $19 per couple, which includes bowling, prizes and buffet. Entry forms can be obtained at the BERA Sales Office or call Rich Scheidet, Ext 5284.

**Purple League**

High games were bowled by Bob Barberich 221/202/605 scratch, Ken Asselta 204, Bob Jones 203, Joe Ferrante 201, Marge Stoeckel 194, Lee Barberich 190/180, Linda Wasson 190, Sharon Smith 185, Millie Connolly 183.

**Red/Green League**

R. Larsen rolled a 240, J. Ferrante 219, K. Riker 216, J. Petro 215, T. Prach 202.

**White League**

Ken Riker had a 212, Jim Roesler 207/200, Joe Mayeski 201, Mary Scheidet 186, Jeannette Thiede 184, Kay Conkling 179/174.

## Cooking Exchange

The men will demonstrate their favorite recipes on Wednesday, February 26, from 12:30 to 2:30 p.m. in the Recreation Building.

A charge of $1.50 entitles each person to copies of the recipes and samples of the food prepared. Babysitting is provided at 50¢ for each child. For more information, call Sara Morse, 286-1712; Susan Sears, 744-7831; or Lucia Cardoso, Ext. 3071.

## Basketball

**Game 1**

| Longshots - 95 | | Coasters - 75 | |
|---|---|---|---|
| L. James | 18 | M. Williams | 17 |
| J. Garrison | 19 | B. Allen | 17 |
| R. Seymore | 9 | R. Rowley | 7 |
| L. Walcott | 12 | G. Griggs | 14 |
| M. Colon | 23 | J. Gaeta | 6 |
| B. Johnson | 6 | P. Ratzke | 6 |
| R. Church | 8 | L. Lawrence | 8 |

**Game 2**

| Runaways - 67 | | Hollywood - 60 | |
|---|---|---|---|
| G. Shepherd | 4 | G. Mack | 11 |
| T. James | 18 | R. Domenech | 14 |
| J. Desmond | 8 | R. Kowalski | 3 |
| J. Ripka | 8 | E. Meier Jr. | 14 |
| R. Moran | 15 | B. Jasper | 4 |
| A. Stillman | 2 | D. Nordstrom | 14 |
| P. Johnson | 12 | | |

## Singles Club

There are still openings for the Mount Brodie ski trip, March 14 to 16. For information and reservations, call Doris Terry, Ext. 2228.

## IBEW Meeting

Local 2230, IBEW will hold its regular monthly meeting on February 24, at 6 p.m., in the Knights of Columbus Hall, Railroad Avenue, Patchogue. On the agenda will be regular business, committee reports and the president's report. As well, the executive board will report on selling the present 1984 automobile and purchasing a 1986 model car.

## Arrivals & Departures

**Arrivals**

**Jeffrey A. Campbell** ..... Chemistry

**Departures**

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

**Robert T. Drew** ..... Medical
**Joan P. Lankford** ..... Contr. & Proc.

# Classified Advertisements

## Autos & Auto Supplies

81 CHEVY CITATION - 4 spd., a/c, 3 dr., low mi., $1,400. Gagliardi, Ext. 3084.

75 SAAB - GLE int., am/fm cass., new muff., best offer. Damian, 924-8686 days or 744-5079 eves.

75 TORINO WAGON - a/t, p/s, p/b, a/c, new tires, recent alt., batt., $850. Ext. 2591.

SNOW TIRES - (2), for truck, 1200 16.5, good cond., $50. Dick, Ext. 3499 or 589-9103.

SNOW TIRES - (2), 15", H78, mounted on '73 Buick rims, $20. Oster, 589-2648.

74 TORINO - 75k mi., a/t, 302 c.i., p/s, p/b, am/fm cass., recent tires, brakes, batt., water pump, $950. 281-0360 after 6 p.m.

REPAIR MANUALS - (4), for MG Midget & Austin Healy Sprite, '58-'78, $5 ea. or $15 for all. Al, Ext. 2043.

81 ESCORT - a/c, good cond., comp. overhaul, 61k mi., am/fm cass., $3,000. Vic, Ext. 2173.

77 FORD LTD - good cond., $800; '80 CHEVY MALIBU, good cond., $1,000. Ext. 3084.

72 DODGE VAN - new starter, radiator, water pump, batt., exhaust, $850. Stenby, Ext. 4590.

65 CHEVY NOVA II - good for parts, low mi. on eng., make offer. Paul, Ext. 4212 or 732-0981.

77 HARLEY SPORTSTER - 11k mi., excel. cond., $2,850; '82 BUICK, 51k mi., a/c, p/s, p/b, radio, 4 dr., good cond., $4,850. Tony, Ext. 4605.

76 BMW 2002 - Weber carb., good cond., $4,300. Ext. 4228.

82 FORD 100 - pickup, cap, 6 ft., fleet, stand., V6, p/s, p/b, red/black, $3,500. 821-9296.

81 CHEVY CITATION - 4 spd., 4 dr. sedan, h/b, new clutch, $2,450; '81 MERCURY Lynx, 4 spd., excel. running & int., $1,850. 724-7354.

76 OLDS CUTLASS - a/t, a/c, 58k mi., radials, runs well. Les, Ext. 5180 or 751-7746.

AM/FM RADIO - works fine, best offer. Jim, Ext. 2432.

79 FIAT - manual, $300. Mow, Ext. 3064 lunchtime.

74 AMC MATADOR - good for parts, radio, speakers, etc., make offer. Ext. 2529.

74 CHEVROLET PICKUP - good mech. cond., cap. Ext. 3841 or 286-9450.

74 MG MIDGET - needs new top & minor body work, $700 firm; '75 VW BUG, reb. eng., 45k mi., $950 firm. Ext. 7633.

73 CAPRI - 4 spd., 2000cc, for parts, $150. Ext. 7603 or 821-0754.

79 PLYMOUTH HORIZON - $1,800 neg. Ext. 3222.

78 OLDS CUTLASS SUPREME - very good cond., low mi. 475-2028 after 7 p.m.

70 NOVA - candy apple red, a/t, new brakes, exhaust, paint & batt., $900 neg. 331-2646 after 6 p.m.

RIMS - great for snow tires, 14" for Chrysler, Plymouth, Dodge, also 15" for Ford, $10 ea. Frank, Ext. 4584 or 277-0464.

70 CHEVY MONTE CARLO - mech. sound, very rel., $400 firm. Scott, Ext. 4581 or 727-1429 after 5 p.m.

74 PLYMOUTH - good cond., new batt., good tires, incl. snows, $270. Michael, Ext. 4707 or 4494.

75 TRIUMPH SPITFIRE - 32k mi., (2) tops, am/fm, good cond., best offer over $2,000. 744-2169.

75 VW RABBIT - for parts, you tow, best offer. Pat, Ext. 4255.

77 FORD GRANADA - 2 dr., V8, p/s, p/b, bucket seats, very clean, 54k mi., $1,500. Ext. 4081 or 874-3844.

## Boats & Marine Supplies

PROPELLER - 3-blade, 17" dia. x 12" pitch, for 1-1/4" shaft, $50. Ext. 4745 or 722-4076.

26' PEARSON - 1972, 15 HP engine, (5) sails, d/f. Ext. 3921 or 689-9214.

CATALINA SLOOP - 1982, excel. cond., $8,500. 589-5490.

17' BOWRIDER - 1982 Glassmaster, 115 Mercury, Shoreline galv. trailer, full canvas, excel., $6,500. Ext. 3341 or 981-9474.

## Miscellaneous

WOMAN'S COAT - size 8, dbl. breasted, reefer style, taupe, worn once, excel. cond., $75. Jean, 821-3963.

DIAMOND RINGS - .53 ct. solitaire, $1,100; .25 ct., $350; 6-diamond wedding band, $350. 286-3211.

GAS RANGE - 30", Welbilt, avocado, w/hood; kitchen sink, both in excel. cond., $150. 821-1215.

CHAIN LINK FENCE - 6' high, 70' long, 3' wide, gate & posts, excel. cond., $60. Dick, Ext. 3499 or 589-9103.

HEATH TRANCEIVER - HW16 w/VFO, antenna tuner, SWR meter, coax switch, $200; countertop range, stainless, $40; Tappan wall oven, $40. Oster, Ext. 3876.

CARTRIDGES - Airequip, metal-slide, $1 ea. or 6/$5. I. Meyer, 929-4326.

WOMAN'S DRESSER - 60", matching mirror, night table, fruitwood, $125; mahogany upright dresser, $50. Ext. 8284 or 878-0074.

WALLPAPER - (5) double rolls, rusty brown, each covers 8'x8' wall, $8/roll. Susan, Ext. 4267.

SKIS - men's, 205 cm & 200 cm, size 10 med. boots; woman's 185 cm, size 8. 475-0509 after 6 p.m.

TRIPLE LOCKER - double door, industrial, beige, never used, 18"x72", $250. 654-5905.

GREEN HOUSE - poly-type, 22'x100', boiler, whole-house heat & vent sys., sprinkler sys., heavy duty const., $3,000; headboard, upholstered, w/bed frame. Jim, Ext. 4040 or 289-0876.

WORDSTAR 3.3 - new, MSDOS, $100. Julius, 365-4720 days.

GIRL'S SKATES - roller skates, size 12; ice skates, size 1, $4 ea. Jim, Ext. 2432.

LIVING ROOM SET - sofa, (2) chairs, ottoman, good cond., velvet, $225 complete; (2) marble top tables & (1) cocktail, good cond., $200. A. Romano, Ext. 4024.

FIREWOOD - split, seasoned oak, 4'x16'x20-22" pieces, $110 delivered. 732-2849.

COCKTAIL TABLE - Bassett, hard rock marble, 56"x21", 2-drawer, $125. Al, Ext. 4615 or 751-8462 after 5 p.m.

GENERATORS - brand new, 4-5-7 KW; transfer switches for elec. generator. J. Medina, Ext. 7363 or 654-3472.

COCKTAIL TABLE - driftwood w/glass top and matching table lamp, $125. Jim, 265-8551.

COLONIAL LIVING ROOM SET - queen conv. couch, love seat, chair/ottoman, pine coffee table, end & corner tables, $950. Ext. 7727 or 929-4631.

BEDSPREAD - Comfaspread, full size, w/2 shams, 3 pr. 45" curtains, brown calico, like new, $35. 286-3847.

COAL STOVE - Franco Belge self-feeding, excel. cond., w/150 lbs. coal, $500. Ext. 4081 or 874-3844.

LA MACHINE II - new, model V588, large bowl capacity, w/attachments, $30. Al, Ext. 4615.

DESK - 48x72, wood w/brass trim, needs refinishing, $100. 744-2821.

SNOW THROWER - Sunbeam Snow Champ, 12", like new, elec. Kevin, 878-4285 after 5:30 p.m.

BRASS & COPPER PANS - and pot rack. Ext. 7225.

## Free

KITTENS - 3 mos. old, long hair; also adult neutered cat. 744-2821.

HONDA TIRES - (2), slightly used. Don, Ext. 5373.

## Car Pools

STONY BROOK - van needs two members. Paul, Ext. 2476 or Sid, Ext. 4125.

SETAUKET - join existing pool. Alicia, Ext. 3630.

HAMPTON BAYS - part time, nonsmoking. Joe, Ext. 2898.

## Lost & Found

FOUND - NY license plate in front of bldg. 179A. Ellen, Ext. 2816.

## Real Estate

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

## For Rent

PORT JEFF. STA. - new, 2 bdrms., l/r, full kit., full bath, w/w, sep. ent., $550 mo. plus util. 928-3033.

CENTER MORICHES, S. - 3-1/2 lg. rms., priv. ent., refrig., w/w, full bath, no children/pets, 1 mo. sec., immed., $550 mo. incl. all. 878-0480 eves.

CORAM - new Bretton Woods condo., 2 bdrms., 2 baths, l/r, d/r, eik, w/w, 5 appl., golf, tenis, clubhouse, no pets, $750 mo. plus util. & 1 mo. sec. 289-0413.

YAPHANK - house on wooded 2 acres, 2 bdrms., eik, l/r, bsmt., 10 min. to Lab, $650 mo. John, Ext. 3675 or 924-3528.

SHOREHAM - furnished studio apt., priv. ent., no pets, $400 mo. incl. util., 1 mo. sec. 744-6648 eves.

PORT JEFFERSON - Harbor Hills, 3 bdrms., 2-1/2 baths, l/r, d/r, f/r, patio, gas heat, central a/c, near beach/country club, partially furnished or unfurnished, $900 mo. 928-0466.

PORT JEFF. STA. - brand new contemp. house, 4 bdrms., 3 baths, d/r, eik, l/r, den, bsmt., 2-car garage, $1,200 mo. plus util. 698-6470 or 751-8707.

## For Sale

AQUEBOGUE - 3 bdrm. ranch, 1-1/2 baths, 1-1/2 car garage, extras, $14k, assum. mort. at 8.5%. 722-4644.

BROOKHAVEN HAMLET - (12) prime acres, Fire Place Neck Rd., former nursery, trees & shrubs, estate surroundings, 12"-14" top soil, lg. barn, (2) 4" wells, terms. Jim, Ext. 4040 or 289-0876.

PORT JEFFERSON - Harbor Hills, 3 bdrms., 2-1/2 baths, lg. den, l/r w/cathedral ceiling, d/r, eik, bsmt., priv. patio, garage, 1/3 landscaped acre, priv. beach rights, $159,000. 928-2803.

MASTIC BEACH - 3 bdrm. ranch, l/r, d/r, eik, den with f/p, $88,000. 399-4840 eves.

## Wanted

VIOLIN - 3/4 size, good cond. Gamo, Ext. 3187.

WOODED LAND - 100x100 level, in Brookhaven Town, under $30k. Richard, 821-9296.

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

HIGH CHAIR - reasonable. Ulrich, Ext. 2341 or 821-2716.

HOME - for female Beagle, friendly & very clean. Bill, Ext. 4428.

HOUSE - to rent, 2 bdrm., Bellport or nearby, S. Country SD. Bill, Ext. 2378.

AIR COMPRESSOR - 1/3 or 1/2 HP. Ext. 3589.

SERIOUS MUSICIANS - to form group for gigs, must have own transp. Jim, 727-7389 after 6 p.m. or weekends.

FILE CABINET - 4-drawer, stand. width, pref. wood, reas. Ext. 2180.

HOME - for lovable 2-1/2 mo. old boxer puppy. Don, Ext. 5373 or 286-0999.

TURNTABLE - must play 78 rpm; software for Macintosh Apple computer; small inexpensive speakers. 928-2803.

## Classified Ad Policy

**Deadline is 4:30 p.m. Friday for publication Friday of the following week.**

1. The Brookhaven Bulletin's classified section may be used only by active and retired Laboratory employees.
2. All items for sale or rent must be the advertiser's property.
3. Ads for material acquired for resale in association with a full or part-time business cannot be accepted.
4. Ads for the sale or trade of firearms will not be accepted.
5. Ads not carried because of space restrictions will be held for publication in the next issue.
6. Ads are run only once and must be resubmitted if they are to be repeated. One ad per person per week.
7. **Property for sale and rent cannot be accepted on this form. Special Real Estate Ad Forms are available at the office of the Brookhaven Bulletin, Building 134.**

☐ For Sale: Autos & Auto Supplies ☐ For Sale: Miscellaneous ☐ Lost & Found ☐ Free
☐ For Sale: Boats & Marine Supplies ☐ Car Pools ☐ Wanted ☐ _____

Please print your ad below in 15 words or less using one word per block. Include name and phone number to call.

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**Note: The following must be completed for your ad to appear.**

NAME (Please Print) .....

Employee's Signature ..... Life No. ..... Ext. .....

Send to: Brookhaven Bulletin, Building 134 (Ext. 2345).