BROOKHAVEN BULLETIN
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BROOKHAVEN NATIONAL LABORATORY

1979 In Review

The strength and diversity of Brookhaven's research programs is made strikingly clear by the departmental contributions to this issue of the Bulletin. We do of course, have problems of limited budgets, higher fuel and utility costs, and many other effects of continuing inflation. Despite this the Laboratory has much to be proud of and much to anticipate.

The construction of ISABELLE, the largest authorized capital construction item in the DOE budget, is going well. The project is on schedule and in its construction new frontiers are being passed in important new technologies. Without question this machine will be of the highest interest and excitement to physics when it is completed.

The National Synchrotron Light Source also portends well for our future. Due to produce beams in 1981, it continues our proud tradition of creating and operating fundamental scientific tools of great utility to the academic and research community. The NSLS will attract not only faculty and students from universities but also industrial users – thus extending our circle of collaborators.

From Tradescantia *to transmission lines, from brain scans to studies of the New York Bight, from solar neutrinos to solar homes, our wide ranging research is fundamental, sound, useful, and fascinating. We have every right to be proud of our scientists, engineers, professionals, and technicians.*

We have an equal right to be proud of all those who serve to make this enterprise work as a unit. I am continually impressed with the appearance of the Laboratory and its grounds; with the high skill of our craftpersons and supporting staff; with the quality of food services and housing; with fiscal, budget, and personnel divisions; and with all the service units of the Laboratory. Our people are friendly, cooperative, and self-reliant.

Brookhaven will remain a very good place to work and will become an even more exciting scientific institution in the 80's.

—George H. Vineyard, Director

Accelerator

The Accelerator Department is constructing ISABELLE and runs the AGS. It is also developing a superconducting power transmission line, and is studying technologies which are applicable to fusion devices. During 1979, notable achievements were made in all of these areas.

ISABELLE

The most visible achievement was the work on the ISABELLE site. In spite of the wettest spring on record, the "donut"-shaped area 2½ miles in circumference and comprising 200 acres was cleared by the middle of May, and the preliminary precision survey was completed with the assistance of the National Geodetic Survey. A design and construction supervision contract was signed with the architecture/engineering firm of Amman & Whitney/Safeguard Construction Management Corporation. Contracts for completing the initial two-thirds of the machine tunnel were awarded to the A.D. Herman Co. To date, one-half million cubic yards of dirt have been moved, 45,000 cubic yards of concrete poured, and 350 tons of steel arch (held together with 80,000 bolts) have been erected.

Of the many technical components that will constitute ISABELLE, the most crucial are the approximately 1100 superconducting magnets which will guide the two counter-rotating proton beams. About one dozen prototype magnets, wound by industry, were completed and underwent exhaustive tests. As we go to press, bids for the initial batch of production magnets are going out, with the first units expected next summer.

Essential, too, is the refrigeration system which must maintain these magnets at −450°F. Two very large refrigerators are now on hand; one, "Pat," is to cool individual magnets undergoing tests; the other, the "R&D Refrigerator," is being used to verify the design concepts of the full-scale unit for ISABELLE. The R&D Refrigerator will also be used in conjunction with a 150-ft long tunnel section which, when

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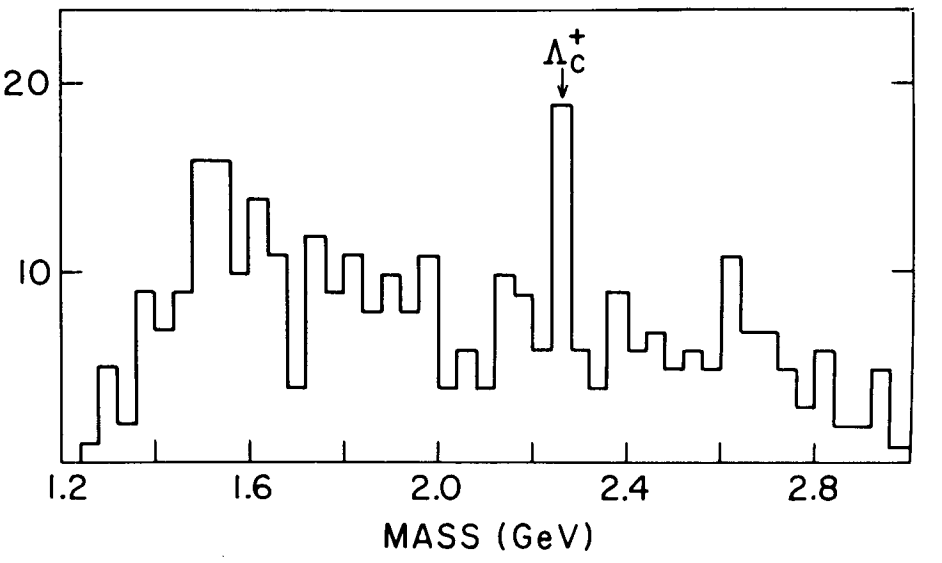
The latest aerial view of the ISABELLE construction site.



Mass spectrum for charmed baryon candidates.

Physics

High Energy

It was discovered in 1964 at the AGS that there is an asymmetry in nature between a particle (K meson in this case) and its antiparticle ($\bar{K}$). Recent theoretical advances in unifying the weak and electromagnetic forces have given some insight into this phenomenon. Some of these theories have predicted a measurable violation of time reversal invariance in K meson decay, leading to a forbidden spin component in one of the decay products. A BNL-Yale group collected twelve million K meson decays in two months of running at the AGS and determined that the ratio of the forbidden spin component to the allowed spin component is $0.004 \pm .0092$. If nature has broken this symmetry, it must be at a very small level indeed!

One of the major advances in high energy physics in the past several years has been in the general area concerning quarks, which are thought to be the ultimate constituents of matter. The family of quarks now includes the charm quark and one or more quarks with "new flavors," in addition to the up, down and strange quarks. The Physics Department continues to play a major role in the unfolding story involving charmed quark systems. The charmed baryon Λ_c^+ (2260), reported in last year's Review in the Brookhaven Bulletin, has been confirmed this year in an experiment of BNL/Columbia collaboration. As shown in the accompanying figure, a clear peak is seen at mass 2260 MeV, in agreement with the earlier BNL reports. This state has since been confirmed by several other experiments at CERN in Geneva and at SLAC in California.

Solid State

A study of hydrogen in metals was a principal activity of the research effort within solid state physics in 1979. Many transition elements are known to dissolve large amounts of hydrogen, but the microscopic mechanism of hydrogen dissolution and the interaction of H atoms with metal lattices are still not understood. Recent advances in surface science have made it possible to study the transport of hydrogen from the gas phase into bulk material. Somewhat surprisingly, very clean surfaces of niobium (or tantalum) have very low uptake rates for hydrogen. However, it was discovered that a single layer of palladium atoms deposited on the metal substrate causes a dramatic increase in the rate of flow of hydrogen through the surface region. With this surface layer, essentially every H atom incident on the surface enters the bulk and goes into solution. The increase in hydrogen uptake occurs just at the point where the palladium overlayer changes its geometrical shape from that of niobium to that of bulk palladium.

Once the hydrogen atoms are in solution they reside within well-defined crystallographic sites and diffuse through the solid by jumping from one site to another. Inelastic neutron scattering techniques have been used to study the vibrational energies of hydrogen atoms within these sites. This provides direct information about the local potential at the hydrogen sites. As the temperature is increased, the hydrogen atoms jump more rapidly from site to site and the vibrational energies decrease. This reflects the effects of hydrogen disorder and the subtle interaction between th : H atoms and the metallic host.

Nuclear

For many years most nuclei have been grouped into one of two special classes corresponding to two different symmetry schemes. Called vibrational and rotational nuclei, they could be pictured respectively as nuclei which could oscillate, or vibrate, such that their average shape was nearly spherical, and as deformed (typically football shaped) nuclei which could rotate. Unfortunately, many nuclei do not resemble either of these ideal limits. Within the last few years a new model has been developed, called the Interacting Boson Approximation (IBA) model. It attempts a rather different approach to questions of nuclear structure, and one of its predictions is that there should be a third symmetry, called the 0(6) limit, occurring on the same footing as the other two.

At the same time, physicists at BNL, using the neutron capture facilities of the HFBR (and in collaboration with a group centered in Grenoble, France), were studying the properties of the nucleus ^{196}Pt

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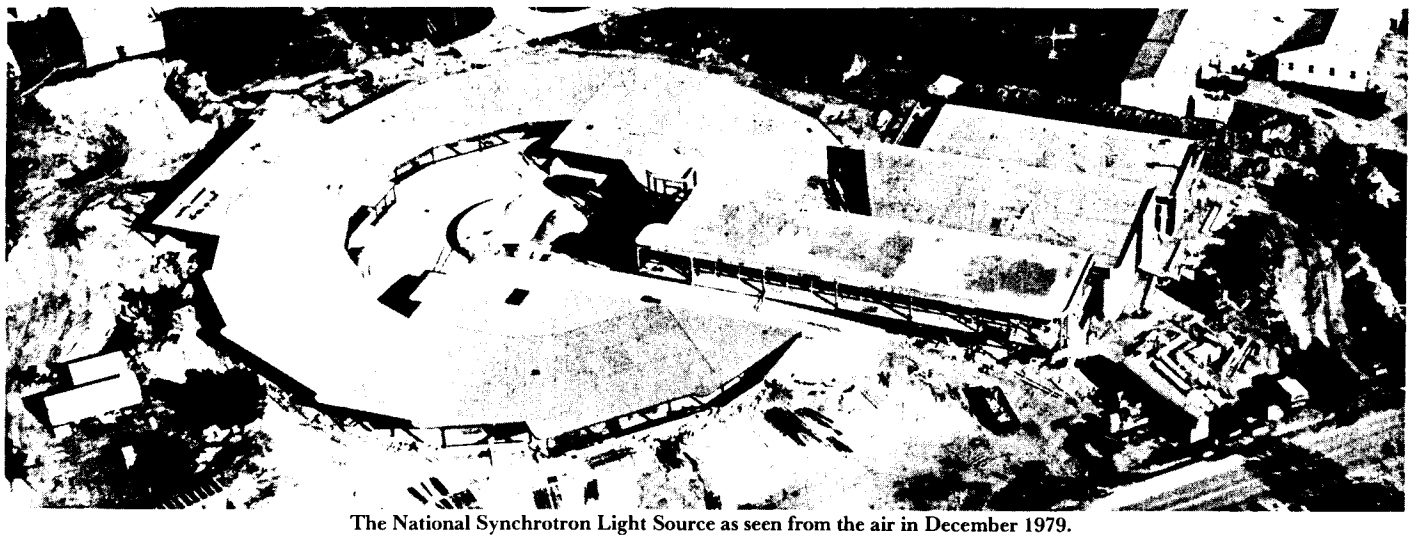


The National Synchrotron Light Source as seen from the air in December 1979.

National Synchrotron Light Source

With two years to go before completion, the National Synchrotron Light Source (NSLS) is moving ahead rapidly on many fronts. As all who pass the site on their way to the bank will attest, the architectural features of the NSLS have begun to reveal themselves and give promise of a building well suited for its prominent location at the Laboratory. Beneficial occupancy of the portion of the building that houses the Vacuum Ultraviolet (VUV) storage ring took place in mid-December. The entire building is slated for completion by October 1980. Early occupancy of portions of the building will enable the staff to assemble the VUV storage ring, booster synchrotron and linear accelerator, so that research can begin by July of 1981.

Although beneficial occupancy of the VUV area was delayed by some months, substantial progress has taken place on the overall construction program. Essentially all of the components of the Vacuum Ultraviolet storage ring (700 MeV e^-) have been fabricated and are ready for installation. The exceptions are the main dipole magnet and the accelerator cavity, both of which will be completed early in 1980. The central control computer system has been in operation in Building 925 for most of the year and this hardware has performed with a high degree of reliability. Software for user programs, the Nova-based communications system and the microprocessor system code is at an advanced stage of development. The overall computer system has already performed a vital role in the magnetic field measurement program associated with the dipole magnets.

In addition to the VUV ring components, fabrication of many components and subsystems has been started for the Booster Synchrotron and X-ray Storage Ring, together with magnetic elements for the beam transfer lines. The major components for the X-ray ring radio-frequency system are on order and the vacuum system and beam diagnostic system are well advanced.

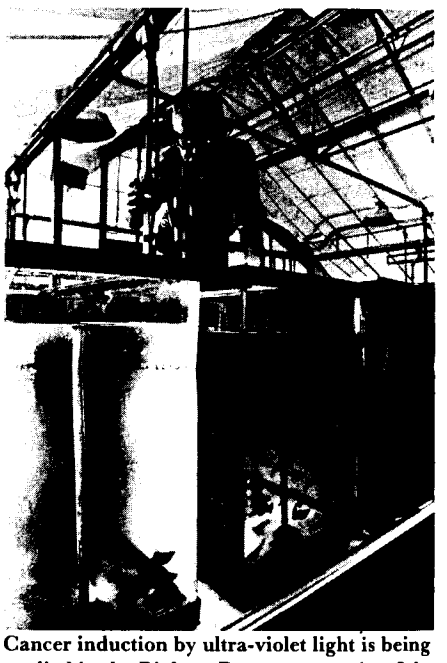
The progress in storage ring construction has prompted considerable effort in the design of photon lines for the VUV and X-ray rings, and construction of several of these instruments is under way. In addition to the instruments that are being built by NSLS for general use, a number of experimental facilities will be built by so-called Participating Research Teams (PRT's). Many future users have interacted with the NSLS staff in anticipation of facility operation by the end of 1981. There are presently about a dozen PRT proposals under review.

Biology

Research at the Biology Department concentrates on fundamental relations between structures and functions of biological systems that range in size from simple viruses and cells to human skin, fish and plants. We use this information to estimate how relationships may be altered by physical and chemical environmental agents. A knowledge of structures is an important first step.

This year the Brookhaven Scanning Transmission Electron Microscope (STEM) has become available as a Biotechnology Resource to biomedical scientists throughout the United States. The STEM is the only electron microscope capable of observing single, heavy atoms in frozen specimens and this capability has been exploited by many users for structural studies, such as DNA sequencing. Quantitative analysis of the scattering of the electron beam by individual molecules has been used to determine the masses of several enzyme complexes with and without the addition of heavy metal atoms. The sensitivity of the instrument is great enough so that single uranium atoms may be visualized in real time as moving about in the microscope field of view.

Studies of the structure of one end – the tail – of the major contractile protein of muscle called myosin have been done using a knowledge of the sequence of amino acids in the protein and computer modeling. The end of myosin analyzed is known to resemble, in some respects, a two stranded rope, and the computer modeling shows that contrary to expectation the pitch of the rope varies along its length. These variations appear to dictate the geometry of the packing of the myosin molecules in muscle.



Cancer induction by ultra-violet light is being studied in the Biology Department using fish.

Analysis at the level of cells has dealt with the uptake of DNA by bacteria so as to change the genetic composition of the recipient cell, a process called bacterial transformation. When closed circular DNA is added to pneumococcal cells, the initial step in DNA uptake by the transformable bacteria is the binding of DNA to the outer surface of the cell. The crucial point is that the binding entails a single cut in one strand of the DNA duplex.

Studies have been carried out on ultraviolet (UV) reactivation in bacterial systems. This type of reactivation represents a phenomenon in which the survival of an irradiated virus is increased by small doses of UV given to cells before infection. It was shown earlier that, in the bacterium *E. coli*, cells must make new protein to accomplish UV reactivation and that the reactivation is accompanied by an increased mutation of the infecting virus. These data were taken as evidence that mutation results from the induction of proteins involved in what has come to be called error-prone repair.

Such reactivation also takes place in the transformable bacterium *Haemophilus influenzae* and again there is a requirement for protein synthesis. However, the results obtained this year indicate that there is no accompanying mutation of the bacterial virus, thus demonstrating that generalizations obtained from studies of a single type of organism can be misleading.

In the world of plants, studies have been made on the replication of DNA so as to

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Chemistry

Research activities in the Chemistry Department include a number of basic studies related to energy production, conversion, or utilization. Programs that require experimental facilities unique to BNL are also an important part of the departmental effort. For example, the anticipated start-up of the National Synchrotron Light Source in 1981 has led to considerable activity in designing and planning four beam lines to be used by members of this department for studies in energy transfer mechanisms, photoionization, crystallography and photoelectron spectroscopy.

In several research programs, lasers are indispensable tools, either to probe reactions occurring on a picosecond time scale, or to supply energy to molecules that subsequently react. With laser light, molecules may be excited into one specific excited state, and the transfer of this energy into other excited states followed as a function of time. The goal of these experiments is to understand which specific excited state of the molecule leads to what kind of chemical reaction and why.

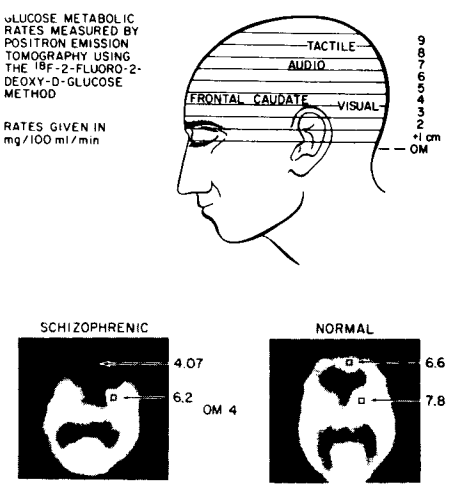
In a move which may set a precedent for other theoretical chemistry programs, a dedicated minicomputer system to be used for large-scale calculations of chemical reaction dynamics was installed, and is now operating. In addition to the usual numerical output, the facility is also capable of making motion pictures from the calculated reaction data vividly illustrating how simple chemical reactions take place.

In the area of inorganic chemistry, electron-transfer reactions of ruthenium complexes have been extensively studied. These compounds undergo photochemical reactions that produce hydrogen from water, and hence provide models of systems for the collection and storage of solar energy. Related theoretical work has focused on calculations of the energetics of electron-transfer reactions. A new program has been started, concentrating on the synthesis and characterization of metal cluster compounds (molecules containing three or more metal atoms). These compounds are closely related to an important class of catalysts.

The use of deoxyglucose labeled with fluorine-18, and positron emission tomography to determine metabolism rates in an intact human brain, has been extended to a comparison of metabolism patterns in normal and schizophrenic subjects. The success of this program in the synthesis and use of radiopharmaceuticals has been recognized by the National Institutes of Health with the award of a five year grant to a Chemistry Department-Medical Department-New York University research team for the study of brain receptor sites.

In nuclear chemistry, the search for neutron-rich nuclides has led to the discovery of uranium-242 and neptunium-242, the heaviest isotopes of these elements to have been characterized to date. Knowledge of their nuclear properties will aid in the prediction of properties of the still-to-be-found super-heavy elements.

As part of the program in which nuclear techniques are applied to problems in art and archaeology, the well-known method of carbon-14 dating has been extended to samples containing as little as 10 milligrams of carbon. This technique should have an important application to the dating of very small or very old samples, and should have important application to fields as varied as archaeology, hydrology and environmental studies.



Areas of higher glucose metabolic rate at a particular level of the brain are shown with increasing brightness in the positron emission tomographic scans. Indicated here is the relatively low metabolic rate in the forebrain of a schizophrenic patient as compared to a normal subject.

Nuclear Energy

The Department of Nuclear Energy continued to strengthen established programs in its areas of special competence, particularly reactor safety, nuclear materials safeguards and the various projects of the National Nuclear Data Center. At the same time our exploration of new directions has resulted in expansion to include an important new program in nuclear waste management.

There has been an increased effort on the fast mixed spectrum reactor (FMSR) concept originated by DNE in 1978. This was recently judged the only promising new concept for achieving U.S. objectives of non-proliferation while at the same time extending utilization of uranium resources. A newer design variation which allows very limited and controlled reprocessing has been shown to have unusually good safety characteristics, as well as excellent performance over very long fuel cycles.

The department has been working with the Nuclear Regulatory Commission (NRC) to identify and analyze safety problems for nuclear power plants of conventional design, both existing and about to be built. A large amount of effort has been devoted to the Three Mile Island incident and related hypothetical incidents. Simulation studies were made to help NRC determine the effects of various possible changes in the mode of reactor operation which should enhance safe performance.

Assuring safe operation of a nuclear power plant requires understanding the behavior of the parts of the plant, and their interactions during a wide range of normal and off-normal conditions. This includes using experimental information and mathematical models of plant components. In some instances it is necessary to examine the experimental information itself to determine whether appropriate experiments and data reduction methods have been used. In others it is necessary to incorporate the data and models into computer codes to simulate the response of the plant to normal and abnormal stimuli. Not only accidents are considered, but also the effects of modifications of the plant, the control system, and the mode of plant operation.

The past year's work included studies of such incidents as break of a steam line, rup-

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Energy & Environment

In the **energy sciences** area, work is directed primarily to developing a basic understanding of advanced systems for energy conversion, storage, and transmission.

Progress was made in fundamental studies of the opto-electronic properties of hydrogenated amorphous silicon in the solar energy program, the fracture toughness of alloys for high-temperature service in energy-producing systems, the strain dependence of critical properties of A15 superconductors which will be used in magnet technology, and the kinetics of hydrogen uptake by transition metals.

Commercial silicate cement was shown to be a highly effective sorbent for the removal of sulfur dioxide produced in the fluidized-bed combustion of coal. The cement is regenerated for recovery of sulfur and can be recycled.

The electrochemistry of a large class of semiconductor compounds (both solid and liquid state) was studied, and relationships among thermodynamic, transport, and electronic properties were determined.

BNL continues to provide leadership for DOE programs in developing nonmetallic materials of construction for use in geothermal energy processes.

In the **energy technology** area, development work was carried out on solar energy, fossil systems, hydrogen storage, electrochemical cells, and conservation.

After one year of operation, the use of the ground for solar energy storage and as a source of thermal energy for a heat pump was evaluated, and acceptable rates of heat transfer were obtained.

An architectural study was completed for a residential building making optimal use of the thermal storage capacity of the building to reduce heating energy needs. The house will be built at BNL and tested to verify thermal performance.

Diesel engines are fuel efficient but present an environmental problem since they emit particulates. The use of alcohols in the fuel mixture and catalytic surfaces on the cylinder resulted in a marked decrease in soot formation in an experimental engine.

A study of coal-oil mixtures as fuels has confirmed potential for reducing the use of premium fuels in boiler applications.

A major facility, the Hydrogen Technology Advanced Component Test System, was completed. In its first test, 50 pounds of hydrogen will be stored in metal hydride form.

The **chemical hydrogen storage** activities include the identification of cost-effective applications of metal hydrides in a rapid cycling mode, investigations into a novel concept for bulk mobile storage and transport of hydrogen, and the conduct of tests of multi-cell solid polymer electrolyte water electrolysis modules in 50 kW and 200 kW systems at General Electric. Hollow glass microspheres capable of being filled to 3000-6000 psi H_2 pressures offer promising cost-effective hydrogen storage and transport applications.

BNL is running DOE marketing demonstration programs on oil-fueled space-heating refit equipment which feature a limited number of options such as the retention-head burner, automatic set-back thermostat, and reduced firing.

In the **electrochemical technology** group, regeneration of the electro-catalytic activities of aged fuel cell electrodes in phosphoric acid was shown to be effective using fast potential cycling. A rapid electrochemical method was developed to determine oxygen transport rates through oxides and metals and how the separator and electrode additives prolong the cycle life of nickel-zinc batteries.

In the **environmental sciences area,** work in the chemistry program has led to a correlation for predicting sulfuric acid emissions based on fuel composition and operating parameters of oil-fired power plants. A technique was devised and is used for the real-time measurement of aerosol sulfur compounds in the atmosphere. New techniques were developed for studying viruses in shell fish and the mobility of polio viruses in soils was demonstrated. It was shown that many streams in the northeast and elsewhere are acidified by rain and that their biota are affected. Experiments in the Multistate Atmospheric Power Production Pollution Study (MAP3s) program showed that vertical air motions can play an important role in the long-distance transport of air pollutants.

Using data obtained from fifty cruises within the New York Bight from 1975 to 1979, division researchers were able to make estimates of annual phytoplankton productivity and zooplankton rate processes. These estimates, supported by data acquired from moored instrumented telemetric buoys, led to the development of a carbon flux model for the coastal shelf of the Bight.

This spring, field studies were carried out in project PROBES (Processes and Resources of the Bering Sea). This interdisciplinary study addresses the physical, chemical, and biological oceanographic properties of the southeastern Bering Sea in an attempt to quantify food-chain dynamics and other variables of the valuable pollock fishery of the Bering Sea.

In March and July, field studies of the northwestern Indian ocean were undertaken to describe the previously uncharacterized biological response of Somali coastal waters to the southwest monsoon.

A comparative analysis of health and environmental impacts of coal gasification, liquefaction, and direct combustion was completed in support of a detailed environmental assessment of coal liquids and alternatives requested of DOE by the Office of Management and Budget.

At the **National Center for Analysis of**

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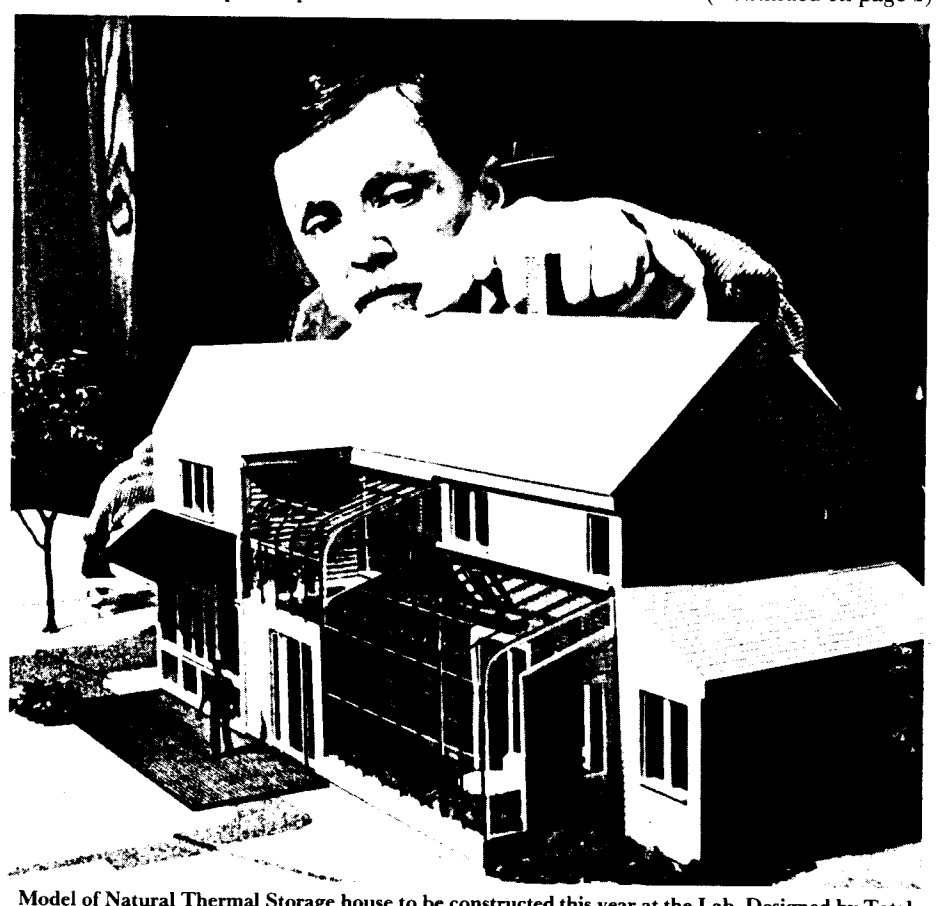
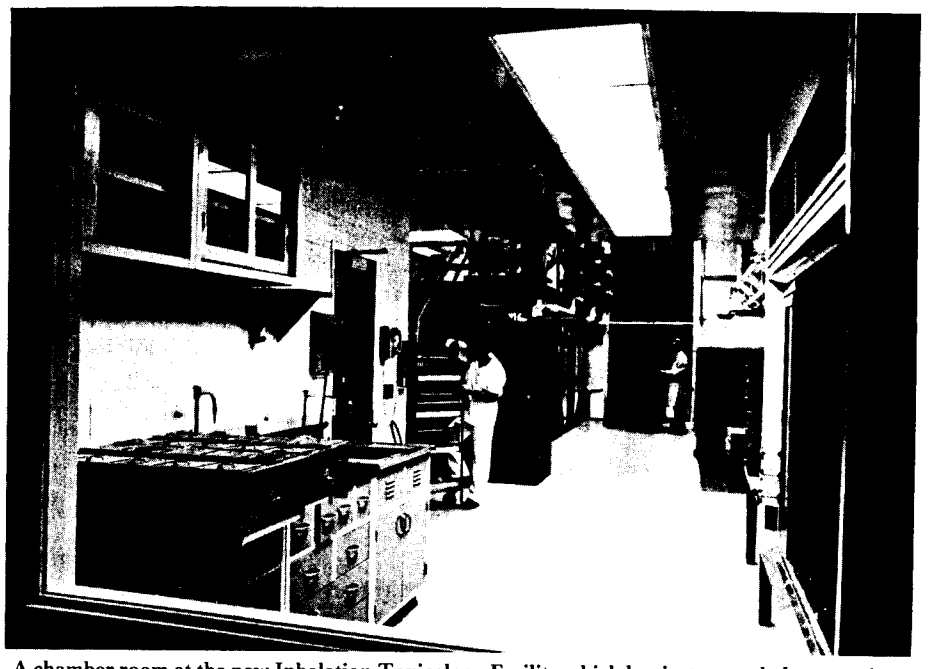


Model of Natural Thermal Storage house to be constructed this year at the Lab. Designed by Total Environmental Action, Incorporated, it makes use of passive solar energy and thermal mass.



A chamber room at the new Inhalation Toxicology Facility which has just recently been put into operation. The chambers are used to assess health effects of airborne pollutants in rodents.

Medical

Research in nuclear medicine resulted in the successful use of manganese 52m for assessment of myocardial function. The low radiation dose to the patient and short half-life of the isotope allow repetitive scans to be made over short time intervals and enable measurement of therapeutic efficacy of drugs commonly in use. Dr. A. Bertrand Brill joined the Medical Department as Head of the Nuclear Medicine Program in September, and will collaborate with Dr. Harold Atkins, and Dr. Alfred P. Wolf of the Chemistry Department, in projects which involve SUNY's Health Sciences Center, New York University Medical School and the University of Pennsylvania Medical School.

A new effort, in collaboration with DEE, focuses on the health effects of photovoltaic materials. BNL has been assigned a "lead mission" role in this area. A defined program of research in the health effects of photovoltaic technology and development will provide the basis for continuing management and control of this effort for DOE. BNL will establish an integrated environmental health and safety assessment model of the photovoltaic industry. More specific projects will include the sampling and evaluation of actual plant effluents and wastes for health effects. The continued use of workshops and planning sessions with DOE's Office of Environment, the Solar Energy Research Institute and the Jet Propulsion Laboratory, is essential to this program.

The portable prompt-gamma facility for *in vivo* measurement of cadmium in liver and kidney made its "maiden voyage" to the southwest United States in August of 1979. Almost 100 retired workers and employees in a cadmium smelting plant were examined. Final analysis of the data is not yet complete but preliminary results promise that the great amount of work necessary on the part of many at the Laboratory (including the local DOE Area Office) to launch the program will prove to be justified. Plans are now being formulated for a second trip to Ohio.

Several department construction projects were completed during the year: a "reverse isolation" unit in the hospital pavilion; renovation of the hospital's sterile central supply unit, adding gas sterilization equipment; and the Inhalation Toxicology Facility (ITF). The ITF is now occupied, and chamber operation has begun. Studies of inhalation effects of glass fibers, ozone, and sulfur dioxide are underway.

Clinical studies of pulmonary function in human beings increased this year as part of the total effort in pulmonary research. A new pulmonary function laboratory was established in the hospital to provide for diagnostic evaluation of lung function.

Many faculty members of the Health Sciences Center, SUNY, joined with the Medical Department in applying to the NIH and participating in a site visit for a General Clinical Research Center grant to do clinical research in the BNL hospital.

Applied Mathematics

The Applied Mathematics Department serves the dual role of conducting research in mathematics, statistics, and computer science, and providing computing services to the Laboratory.

The principal efforts in the research program are in partial differential equations, biostatistics, and distributed processing. A new program within this framework has been initiated in biostatistics, particularly related to statistical questions in epidemiological analysis and low-dose effects. In addition, mathematical studies for the Department of Interior relating to government off-shore oil development policies have begun.

In the computer service area, most efforts center around the support and further improvement of the Central Scientific Computing Facility. A new division, the Computational Assistance Division, was created to handle the diverse problems of helping users in a most responsive fashion. An uninterruptible power supply is being installed to improve the reliability of the computers in the face of frequent utility power interruptions. Equipment is being purchased to provide for the use of very high-speed, high-density magnetic tape, and to develop a basis for a modern computer networking capability.

Nuclear Energy (Cont'd)

ture of steam generator tubes, unexpected shutting down of turbines both with and without compensating protective action, and others. In all these cases it is necessary to take into account the effect of the change in reactor core composition during the life of the plant. In some incidents the automatic control system should shut down the reactor automatically. A study has been initiated to assess the effects of the failure of the automatic shutdown when it is called upon.

Work on the fast breeder reactor Super System Codes (SSC) has progressed well. Refinements have been made in SSC-L, the version for loop-type reactors. The version for pool-type reactors, SSC-P has been further developed, as has the shut-down version, SSC-S, which deals with long-term transients and is applicable to all fast breeder reactors. As a result of Three Mile Island, NRC asked Brookhaven to expand the scope of SSC to include a version applicable to water reactors, to be called SSC-W.

The newly-formed Nuclear Waste Management Division is charged with assisting NRC in the development of criteria and standards for the best method of isolating high level radioactive waste. Experimental work on low-level waste, which has been in progress by the Nuclear Waste Management Research Group, will continue, but the present major thrust of the new division is in technical support to NRC in new areas of high level waste management. The new program emphasizes a multi-barrier approach which represents a change in philosophy from one in which the geologic repository was the main barrier, to one in which the hydro-geologic site is a redundant barrier.

Biology (Cont'd)

determine the size of the replicating units (replicons) and the rate at which the replicons are duplicated (fork rate). Among the plant species studied, there was an 80 fold difference in the amount of DNA per cell. Nevertheless, replicon size and fork rate were similar in all. However, fork rates were appreciably lower than those found in mammalian cells or bacteria. The similarity of replicon properties among many species of plant cells is a welcome simplification for research on chromosome structure, the control of cell division, and mutagenesis in these organisms.

Mutagenesis is an important test system for deleterious environmental agents. Mutagenic effects on flower color were observed in the higher plant *Tradescantia* following exposure to ambient air in highly industrialized areas throughout the country. Based on these positive results from field exposures and confirmation of the true genetic basis for flower color mutation, plans are underway to utilize this higher plant as a short term bioassay for the mutagenic hazard of atmospheric pollutants.

Physics (Cont'd)

which seemed impossible to explain with existing models. When they compared its empirically deduced level scheme with that of the 0(6) limit they found an almost perfect match.

These results suggested further tests. One showed that the very complex series of nuclei in the Pt-0s region could be described much more simply than heretofore as undergoing a smooth transition from the 0(6) limit towards the rotor limit. Another test, just recently finished, concerns levels in ^{109}Pd and is the first test of the IBA model in odd mass nuclei (nuclei with an odd number of either protons or neutrons). Again using the (n,γ) reaction, the BNL group identified for the first time the complete sequence of low spin levels based on a particle in a so-called unique parity orbit ($h_{11/2}$). This permits a test of both traditional models such as the very successful particle rotor model and of the IBA. Briefly, comparisons with those models show serious discrepancies, which appear to be fundamental with the former, and have remarkably good agreement with the latter.

With all these tests there is a developing confidence in the IBA and further tests of it are now under way in many laboratories. If they are also successful, and if the model can be established theoretically on a firm footing, it may well be the most significant development in nuclear structure theory in many years, offering the potential to obtain a unified treatment of widely diverse nuclei within a single simple scheme.

Safety & Env. Protection

The Center for Assessment of Chemical and Physical Hazards (CACPH) has been established within theSafety & Environmental Division. It will facilitate timely development of interim exposure standards to provide appropriate protection against potential occupational and environmental hazards that may be uniquely associated with activities of the Department of Energy. At CACPH, particular emphasis is directed toward the development and eventual promulgation of interim standards for those emerging energy technologies having high probability of commercialization.

The power reactor accident at Three Mile Island near Harrisburg provided a test for the radioiodine air monitoring and dose commitment evaluation system developed for the Nuclear Regulatory Commission. The DOE Region I Radiological Assistance Plan team, RAP, composed of members of the Safety and Environmental Protection Division and a DOE representative, used the air sampling system. Measurements were started on the day of the accident, and continued for approximately a month. A total of about forty-five surface and helicopter borne air samples were taken and evaluated. All samples yielded results which indicated that levels were well below the limit for continuous off-site inhalation.

Joseph Klemish tests radioiodine air sampler using power from automobile cigarette lighter socket.

Energy and Env. (Cont'd)

Energy Systems (NCAES), computer models are among the techniques used to study the complex interrelationships between technological, economic, social, regulatory and environmental factors that influence the energy system. Two of the more recently developed ones are Time-stepped Energy System Optimization Model (TESOM), and Brookhaven Energy System Optimization Model (BESOM).

TESOM, a one-region integrated energy system model, includes a new market penetration algorithm, an explicit representation of capital stock, and the incorporation of risk factors in resource pricing. BESOM quantifies trade-offs between competing policy objectives.

For the Energy Information Administration, NCAES assisted in developing an Energy Emergency Management Information System, which is designed to monitor and assess the U.S. energy system at national, regional or state levels to assist in managing energy emergencies.

An assessment of environmental effects of conservation strategies was completed for DOE's Office of Technology Impacts.

In collaboration with various government agencies, assessments of the energy situation in Egypt and Peru were completed for DOE's Department of International Affairs.

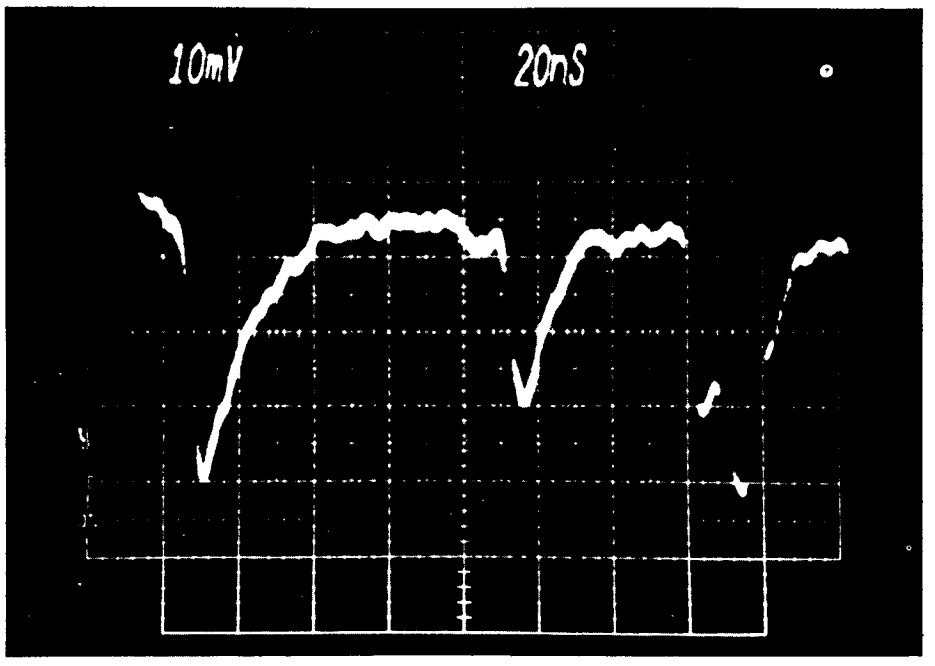
Instrumentation

In 1979 further advances were made in the development of position sensitive particle and photon detectors. Results of this work will be used in detectors for research at ISABELLE, the High Flux Beam Reactor, and the National Synchrotron Light Source.

A new type of drift chamber – the time expansion chamber – has been developed. The time expansion chamber allows the measurement of microscope details of ionization, so that basic ionization phenomena and electron drift properties can be measured at the single electron level. Visualization of the structure of the ionization process makes possible a high sensitivity for different kinds of radiation, which is of importance in extreme low level counting or analytic techniques in the presence of high background radiation. Counting the number of ionization clusters from a track produced by high energy particles permits the measurement of the relativistic rise with higher accuracy than by the measurement of the total charge produced by ionization. Thus, better separation of particle types becomes possible.

A new method for particle position determination was developed. This method makes possible high precision position-sensitive detectors for use in neutron and x-ray scattering and new approaches to high resolution detectors for high energy physics.

New special services, which are not commercially available, were developed. The printed circuit facility has been modernized and, as an example, it can now process patterns on foils and circuit boards two and one half meters long, which are needed for large particle detectors. The Vacuum and Materials Processing Laboratory is being equipped to provide specialized high level services for various technology developments which have to be performed at BNL. Examples of these are the development of detectors based on vacuum and coating deposition techniques, such as detectors with resistive sheets and photoelectronic materials, and the development of techniques for photon-beam optical elements for the NSLS.



Oscillogram showing the signal current from the time expansion chamber caused by the passage of a single particle β^-(^{90}Sr). Individual pulses are caused by clusters of a few electrons, each produced by ionization along the particle track.

Accelerator (Cont'd)

filled with prototype components, will simulate a section of the machine ring under power.

Other areas of intense activity during the year have included theoretical orbit and machine lattice studies, the vacuum system, electrical components and control systems, and experimental area layouts.

In March, the project hosted a symposium on non-linear dynamics and beam-beam interactions, which was attended by about 50 scientists from the U.S. and abroad. A summer workshop was devoted to beam current limitations in storage rings, including the National Synchrotron Light Source, and another workshop focused on the layout of experimental areas for ISABELLE.

Several administrative developments took place during the year. In late summer, Kjell Johnsen, formerly head of our European forerunner, the ISR at CERN, arrived to assume the role of Deputy Project Head. Robert Louttit was named Deputy Head of the Accelerator Division, and a sixth division responsible for the vital area of magnet production, was formed under Edward Bleser. All of these efforts have occupied approximately 265 scientists, engineers, technicians and support personnel.

A G S

During the first half of 1979, the AGS was used for 25 weeks of high energy physics research. Nineteen experiments were performed by visitors from 32 institutions as well as by Brookhaven scientists from the Physics and Accelerator departments. This work included the first use of the new low energy beam, LESB II, and the delivery of a record number of protons at 1.5 GeV/c for the neutrino program. The Multi-Particle Spectrometer was improved, enabling the acquisition of data at higher rates, and so the study of rarer processes.

The AGS was off for most of the second half of the year to permit reconstruction of the "switchyard." This facility distributes the slow extracted proton beam to three external target areas. The beam had been divided by relatively thick magnetic septa, which introduced substantial losses. These septa were replaced by electrostatic devices using thin wires and, at the same time, an additional split was introduced to permit the construction of a fourth target station. Initial tests of the rebuilt switchyard have been successful, and the counter physics research program will resume in early 1980.

Power Transmission

The objective of this project is to develop an underground superconducting power transmission system which is economical and technically attractive to the utility industry. The system would be capable of carrying very large blocks of electric power on the order of one Gigawatt, thus enabling it to supplant overhead lines in urban and suburban areas and regions of natural beauty.

Two 12 meter superconducting cables were made and tested in the laboratory. A 20 meter cable was tested under cryogenic conditions to evaluate the performance of its electrical insulation at these temperatures.

All the cryogenic equipment required for a 100 meter test facility was installed during the year, and two cool-down tests of the complete system were performed.

High Flux Beam Reactor

The planned increase in power from 40 megawatts to 60 megawatts for the High Flux Beam Reactor came much closer to realization in the closing weeks of 1979, as the reactor was shut down to permit installation of larger heat exchangers designed for operation at the increased power level. Experimenters at the HFBR are looking forward to operation at 60 MW, since the 50% increase in neutron flux will allow more experiments to be done in a shorter period of time, as well as increase the range of possibilities for new experiments.

The new heat exchangers are of an improved design which will be more resistant to vibrations. To minimize the loss of heavy water from the reactor primary coolant system, and to provide extra protection against the leakage of radioactive fission products and tritium into the environment, the heat exchangers were subjected to an extensive leak testing program, and passed an extremely sensitive helium mass spectrometer leak test.

Other modifications required for 60 MW operation already have been carried out, principally in the reactor secondary coolant system and the afterheat removal system. With the completion of the installation and testing of the new heat exchangers, the HFBR will await the final phase of safety review and approval by DOE before 60 MW operation can begin in early 1980.

BROOKHAVEN BULLETIN

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BERNICE PETERSEN, Editor
MONA S. ROWE, Editorial Assistant

40 Brookhaven Ave., Upton, N.Y. 11973
Telephone (516) 345-2345

CARL R. THIEN, Public Relations Officer

BROOKHAVEN BULLETIN
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BROOKHAVEN NATIONAL LABORATORY

Call For Volunteers To Lose Weight

The Medical Department is looking for volunteers to participate in a weight reducing program. The object of the study is to determine the changes in body composition during weight reduction and maintenance. Participants should be at least 30% above their ideal body weight, but no more than 100 kg (220 lbs) in weight, 18-40 years of age, in good health, and not taking any medication. The dietary program will be of six months' duration.

Subjects will be admitted to the Hospital of the Medical Research Center for a period of one week at the beginning of the study, then for one week at three and six months. One day will be required during each admission to complete the necessary studies, such as history, physical examination, blood tests, and special studies (determination of total body nitrogen by prompt gamma neutron activation analysis, and total body water by the use of tritiated water).

During the remainder of the hospital stay, attendance at meal times will be essential; otherwise the hospital stay should not interfere with the subject's work schedule. Every two weeks there will be a follow-up visit in the Outpatient Research Clinic, requiring about one hour. It is expected that anyone participating in the research program will benefit directly *by the loss of weight.*

Anyone interested in participating in the research project should stop by at the Research Clinic to fill out a questionnaire. If you have any questions, contact Jean Matkovich at Ext. 3672, or Dr. A.N. Vaswani at Ext. 7584.

Hospitality News

A morning coffee will be held Monday, January 7, from 9:30 to 11:30 a.m. in the Brookhaven Center.

All wives of Laboratory employees are welcome. Please come and bring the children. Babysitting will be provided free of charge. It is suggested that you bring along a toy or two for your child to play with.

These morning get-togethers are scheduled for the *first* Monday of every month. If there is a change in the schedule, a notice will appear in the *Bulletin.* The following is a list of the scheduled morning coffees for 1980:

February 4	August 4
March 3	September 8
April 7	October 6
May 5	November 3
June 2	December 1
July 7	

Cooking Exchange

Imagine yourself in a bougainvillea-covered veranda watching wild parrots flying among mango, orange and banana trees. From such a tropical scene come dishes of Mexico to be sampled at the next Cooking Exchange meeting on January 9.

Meetings are held at the Recreation Building from 12:30 to 2:30. A charge of $1 per person is collected and babysitting is provided at 25¢ per child.

Contact Sharon Golayda, 821-0644, for further information.

Harpsichordist To Perform Here

Fernando Valenti, who is considered largely responsible for the popularity of harpsichord music today, will be featured in the third BERA concert on Monday, January 14, at 8:30 p.m. in Berkner Hall.

His program will include the Handel Suite in F, the Bach Toccata in E minor, and eight Sonatas of Domenico Scarlatti.

Fernando Valenti

Mr. Valenti is internationally known for the brilliance and artistry of his performances in concert and on records. "He is now the most exciting of the masters," says TIME magazine.

Valenti has played under the baton of such greats as Bruno Walter, Serge Koussevitzky, Fritz Reiner, Pablo Casals and Leopold Stokowski. Because of his interpretations of baroque music, he is a much sought after performer in festivals around the world, notably the Bach Bicentennial at Prades, the Festival Casals in Puerto Rico, the Berkshire Festival in Tanglewood, and the Aspen Music Festival.

His recordings of harpsichord music began in 1949. To date, he has recorded about 80 LP discs of Bach, Handel, Rameau, Telemann, Soler and early Spanish music, including 408 sonatas by Domenico Scarlatti.

Tickets are $5 general admission, $3 students and senior citizens, and $2 for those under 18.

Soc. Sec. Taxes

Effective January 1, 1980, Social Security taxes will be deducted on the first $25,900 of each wage-earner's income at the rate of 6.13%. In 1979, the Social Security base was $22,900 and the rate of tax was 6.13%. This means the maximum Social Security tax a wage earner pays in 1980 will be $1,587.67 compared with $1,403.77, an increase of $183.90.

After An Ice Storm

Ice storms can do considerable tree damage. Knowing what to do and how to do it could mean the difference between saving a tree or chopping it up for firewood. The Cooperative Extension has some advice on caring for trees damaged by ice.

The greatest storm injury is likely to occur on faster growing trees like poplars, maples, willows, black locust, and Chinese and Siberian elms. The following first-aid treatments are suggested if you are faced with straightening a toppled tree or mending broken or split branches.

Remove all broken branches. Do all cutting with sharp tools. You may need saws, knives and wood chisels. Make cuts either at a good side branch or nearly flush with the mother branch. This avoids leaving "dead end" shrubs.

Make smooth, fast-draining wound surfaces. Remove splintered, rough, or loose wood from all parts of any wound with a wood chisel or sharp knife.

Trim off all bark not solidly attached to the wood. Using a sharp knife, expose uninjured bark on all edges of the wound.

Recent research has questioned the need for painting tree wounds. However, either orange shellac or asphalt tree wound dressing may be used.

After the wood has thawed, lift, straighten, and support trees, shrubs or evergreen trees with wire (encased in a hose wherever it touches the bark). Supports should remain a full season. Cover exposed roots with soil and mulch with leaves or straw.

New York Train Trip

The Hospitality Committee is planning a group railroad trip to the city on Wednesday, January 16. Departure will be at 7:55 a.m. from the Patchogue LIRR station. Round-trip fare for adults is $2.45, children under six years ride free.

Reserve a ticket by sending your fare through the U.S. mail to P.O. Box 322, Upton, New York 11973, no later than **Thursday**, January 10. Make checks payable to "Brookhaven National Laboratory." Your tickets will be given to you on the train. Refunds will be made only if cancellations are received by the Friday preceding the scheduled trip.

Kayak Maneuvers

The Mountain Club will again sponsor kayak lessons at the Lab pool. Anyone interested in taking lessons, or in just finding out what it is all about, is invited to an open house, on Sunday, January 13, from 10 a.m. – 1 p.m. at poolside. Bring a bathing suit. If you can't make the open house, but are interested, give Dick Watson a call on Ext. 3788.

For Official Use Only

The Department of Energy has received numerous complaints reporting apparent misuse of DOE vehicles. Unfortunately, most of the complaints were found to be valid.

Speeding and unofficial use are the most common abuses. People are understandably aggravated when they see a gas guzzler whizzing along at 65+ miles per hour. When they see a government vehicle speeding, they get even angrier. If the vehicle specifically belongs to the Department of Energy, tempers can really flare.

People are just as offended when they see government vehicles parked at shopping centers and restaurants or used to drop a youngster off at school.

According to Bill Webster, Staff Services Manager, "Official use is the use of a vehicle in circumstances where the lack of a government vehicle to accomplish the travel would result in reimbursement to all the occupants for the alternative method of travel selected. If there are doubts about the validity of the official nature of the business being conducted, one is better off to find other means of transportation."

All key tags of BNL vehicles are marked "BNL business only." The sides of the vehicles carry the words "For Official Use Only." SPI 5-05 states that use of government vehicles for private purposes "contravenes Laboratory policy and is a violation of Federal law."

Federal law 18 USC 641 provides for suspension from duty for not less than one month without compensation or removal from office if circumstances warrant. 31 USC 638 provides that any person who knowingly misuses any government property (including government vehicles) is subject to criminal prosecution and, upon conviction, to fines up to $10,000 or imprisonment for up to ten years.

Enough said?

Pool Reopening

The normal schedule of swimming pool hours will resume on Monday, January 7.

Tickets for the January through April 1980 season will be on sale at the pool during open hours starting on that date.

Zukowski Retires; Neger Heads Bank

Dorothy Zukowski, who managed the Bankers Trust Company bank on site, retired January 3 after 20 years. For a good many of those years, her husband George, also worked on site as a carpenter in Plant Engineering. They have a house in Florida, and when she retires, she and her husband plan to divide their time between Florida and Long Island.

Carol Neger has assumed management of the on-site branch. She has been with the bank for 17 years and managed a branch in Farmingville before coming here a month ago.

Doug Humphrey

Dorothy Zukowski (left) and Carol Neger

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.

The determination of the best-qualified candidate for available positions will be based upon education, experience and other job-related criteria. Such factors will be evaluated and measured against the demonstrable requirements of the available vacancy, as well as the Laboratory's Affirmative Action objectives.

The Laboratory is committed to a policy of Equal Opportunity in its selection and placement of personnel. Its objective is equality of opportunity in employment, training, and promotion without regard to race, color, religion, national origin, sex, age or handicap.

Each week, the Personnel Office lists new personnel placement requisitions. The purpose of these listings is, first, to provide open placement information on all nonscientific 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, as indicated below. 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.

1205. HEAVY EQUIPMENT MECHANIC OPERATOR, GROUP LEADER - (Temporary - 5 months) Plant Engineering Division.

1206. SENIOR STATIONARY ENGINEER, GROUP LEADER - Plant Engineering Division.

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

1207. SENIOR DESIGNER - (three positions) - Requires AAS degree or equivalent with experience in general machine design, fixtures and pressure vessels. Must know welding and machine shop procedures and be able to follow up work in the field. Knowledge of true-position dimensioning and good vacuum technique is very desirable. Accelerator Department, ISABELLE Project.

1208. TECHNICAL POSITION - Requires AAS degree or equivalent in mechanical technology with an emphasis on vacuum pumps, vacuum seals and vacuum leak detectors. Accelerator Department.

1209. COMPUTER SCIENCE ANALYST - Requires BS/MS or equivalent in math or computer science and some scientific programming experience. Will assist scientific staff members with running large standard codes for containment systems loading calculations. May also be responsible for writing small new programs for code analysis. Department of Nuclear Energy.

1210. PLUMBER - Requires successful completion of a four year apprenticeship program and 4 - 8 years of commercial/industrial plant experience including proficiency in working with glass, aluminum, monel, stainless, PVC pipe or tubing systems. Will be responsible for the lay-out, construction, installation, repair or maintenance of water, sewage and gas systems and auxiliary equipment. Plant Engineering Division.

Autos & Auto Supplies

71 CHEVY VAN - C-20, all windows, V/8, a/t. $995. Hank, Ext. 3848, 472-0553.

69 CHEVY IMPALA - V8, ps/pb, running. $200 or best offer. W. Love, Ext. 3996.

75 CHEVY IMPALA STA WGN - ps/pb, a/t, a/c, excel cond, 47,000 mi. $1995. Ext. 3403, 345-3079 eves.

69 MUSTANG - 302 eng, a/t, bckts. $600. Frank, Ext. 2311, 567-5131 after 6.

72 MERCURY MONTEGO STA WGN, 302 V8, 70,000 mi, a/c, p/s, p/b, auto trans rebuilt. B. Style, Ext. 2953.

70 FIAT 124 SPIDER - eng good, body bad, trans shot, tires good. Make offer. Ext. 3812, 751-6111.

SNOW PLOW - Fisher 7½′ pwr angle w/hdwre. $700. 588-5833.

72 CHEVY 8′ PICKUP BODY - Fleetside, lt blue. Best offer. J. Heilig, TU4-4136.

69 VOLVO 144 - a/t, white, low mi, excel cond. Cliff, Ext. 3514, 281-8318.

76 CAPRI - 22,000 mi, a/t, ps/pb, AM/FM 8 trk stereo, V6 & other goodies. 345-2512.

73 FIREBIRD - a/t, ps/pb, good cond, reg gas. 928-8522.

75 BUICK CENTURY CUSTOM - a/c, ps/pb, p/w, stereo, very good cond. Howard, Ext. 4615, 732-2914.

72 MERCURY - 429 a/t, loaded, very good, reg gas, 15 mpg. $695. Hank, Ext. 3848, 472-0553.

58 T-BIRD - compl restored, ps/pb, p/w, mint, AM/FM stereo. Best offer. 698-8086.

78 CHEVETTE - 4 spd std, 2 dr, blue, snows mounted, 4 new Monroe shocks, 22,000 mi, AM/FM 8 trk stereo, excel cond. $3200. Ext. 4144/3254.

72 PLYMOUTH STA WGN - ac/ps/pb/am/fm. $475. Ext. 3335 or 286-0269.

76 CHEVY NOVA - std trans, radials, good cond. $2000. Dick, Ext. 4615, 928-8522.

Miscellaneous

COAL STOVE - sm, attractive, cast iron, made in Scotland, suitable for rec rm. $250. Tom, Ext. 3535, 288-3118.

SLIDE PROJECTOR & VIEWER - manual load. Best offer. Warren, Ext. 3464, 399-2420.

WHEELBARROW - contractor's type, pneumatic tire, $25; CB ½ wave antenna w/mounting brackets & mast, $15. Porcaro, 732-7134.

GE REFRIG - 76 model, new compressor, 13.5. $150. 722-3905 after 5.

TYPEWRITER - Underwood, $10; Toastmaster toaster, $7; GE iron, $1; outdoor Christmas lights. Ann, 286-2280.

WOOD STOVE - thermo-control w/water coils, heat shields, base, thermostatic control, wall shield, flue pipe. B. Espensen, Ext. 3992, 298-4172.

AIR COND - car-top carrier; iron; gas & water cans; camping stove. Ext. 3403, 345-3079 eves.

PORTABLE TYPEWRITER - Smith Corona, excel cond, new ribbon. $30. 475-8658 after 7.

OIL BURNER - Sun Ray mod. DSP, Shell Head, 3 yrs old. Asking $100. R. Cook, Ext. 4592.

RUG - 11′x15′, $45; ice skates, size 7, white, $8. GR5-4199.

GUITARS - Kimberly elec 6 string dual pickup w/strap, case, cord, $100; Hagstrom elec 12 string dual pickup w/strap, case, cord, $150; both mint cond, perf for beginners. Ext. 2972, 475-5789 after 6.

DICTIONARY - Webster Encyclopedia, new, still in box, must sell. Orig $49.95, sell $25. Ext. 3514.

WASHING MACHINE - Kenmore, needs trans repair, highest offer. 473-2473.

WINDOWS - alum, good cond, 2 sizes, both 4 ft. $25 ea. 654-2304 or 732-3073 after 5.

AM/FM CASSETTE - Sanyo portable AM/FM radio w/cassette recorder. $15. 732-5829.

CRIB - matt, dresser, dressing table, good cond, will sell separately. 286-3565.

CHRISTMAS TREE STAND - musical, revolving. Ext. 3392, 475-8330.

MUSIC BKS - asstd, brand new, 50% off printed price. R. Hildenbrand, Ext. 3273.

SKI BOOTS - Munari, buckle type, size 11, w/carrier, excel. $10. Ext. 4316, 924-3783.

FIRESCREEN - glass dppr w/mesh curtain, for fireplace, fits opening 33″-39″w, 28″-32″h, antique brass, like new. Ext. 4449.

MAYTAG WASHER - & gas dryer, excel operating cond. $75 ea or $125/set. 732-3073 after 5.

FURN - odds & ends, chairs, couch, tables, radio, phonograph, sewing machine, etc. Porcaro, 732-7134.

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

BELLPORT - charming older home, prime loc, 4-5 bedrms, 3 baths, den, country kit, lg D/R, ent hall, fp, back stair case, front porch, econ gas heat, 2-car gar, .6 acre, walk to shops, beach, dock, golf, tennis. Mid 50's. Anne, Ext. 3404, 286-3764.

CORAM - Tanglewood Hills, 4 bedrms, L/R, D/R, eik, 4/10 acre fenced, 2-car gar, patio, shed, immac cond, gas heat, 2 baths, must sell. Reduced to $34,000. Susan, Ext. 3404, 698-4966.

NORTH PATCHOGUE - 3 bedrm hi-ranch, fenced yard, improved ceiling insulation, patio, established landscaping, fam rm, D/R, all appl. $39,000. Ext. 4442, 289-3399.

MT. SINAI - 3 bedrm ranch, cathedral ceiling L/R w/fp, w/w, 5 appl, 2 baths, gar. $43,000. Bill, Ext. 3369, 929-6442.

For Rent

PORT JEFFERSON - 3 bedrm house, gar, refrig, dishwasher, fenced yard, like new, unfurn, water incl. $425. 821-0275 weekdays after 6.

SOUND BEACH - 2-3 bedrm house, 1½ baths. Ext. 2926, 281-0268.

RIDGE - 3 bedrm house w/bsmt, gar, big yard, 5 min from BNL. $300/mo. Ext. 2906, (212) 347-7850.

Wanted

CLEANING WOMAN - reliable, experienced, thorough worker. 475-8658 after 6:30.

MOTORCYCLES - bent or broken, any age or cond. Kevin, 281-8031.

BABYSITTER - Blue Point area, school age children. Ext. 3341-4188, 363-5170 after 6.

HOUSEKEEPER - 2 days/wk, sometimes more, 2 children, ages 5 & 6, must be reliable. 744-4611 after 6.

2-MAN SAW - good cond. Bill, 744-8999.

Car Pools

BABYLON/W. ISLIP - driver needed for on-time car pool, 8:30-5:00. M. Tesla, Ext. 3284.

EXIT 41, LIE - leave at 7:45 a.m., return at 6:00 p.m. Bernie, 2027.

BELLPORT - form or join, 8:30-5:00. Graves, Ext. 3326 or 286-0497.

Services

SHARPENING SERVICE - chain saws, hand & circular saws. Joe, 732-3286.

BABYSITTING - Patchogue area, teenager, reasonable, experienced. 475-8268 eves.

MOTORCYCLE REPAIR & ACCESS - expert work done; access for street & dirt. Ext. 2311.

EXPERT TUTORING - by certified teacher in my home, all elem subjects, H.S. math, French, German. $10/hr. 941-4328.

THESES & PUBLICATIONS ILLUSTRATED - med, chem, biol. electromechanical, drawings, charts, schematics, wiring diagrams, instrumentations & lettering professionally executed. Yani, Ext. 2514.

UPHOLSTERY - Sm chairs, cushions, slipcovers, etc, your fabric. Free estimate after 5:30. Irene, 924-9288.

TRUCK & DRIVER FOR HIRE - will pick up or deliver any load, lg step van. 744-5387.

Classified Ad Policy

Deadline is 4:30 p.m. Friday for publication Friday of the next 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. Firearms offered for sale or trade may not be brought on site.
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.
7. **Property for sale or rent cannot be accepted on this form. Special Real Estate Ad forms are available at the office of the Brookhaven Bulletin, 40 Brookhaven Avenue.**

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

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

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 460, 40 Brookhaven Avenue (Ext. 2345).