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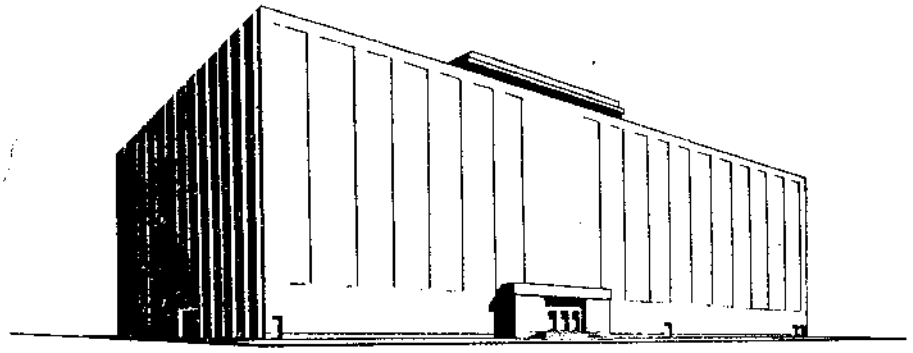

History of

U. S. NAVAL RADIOLOGICAL DEFENSE LABORATORY

for the year

1963

This document is designed to serve the dual purpose of
Command History and Annual Administrative Report

SAN FRANCISCO CALIFORNIA

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CHAPTER I -- CHANGE AND GROWTH

YEAR OF THE CYCLOTRON

An informal ground breaking ceremony for the $3 million High Flux Neutron 70" Cyclotron that Congress authorized to be built at NRDL was held on 6 February 1963. RADM E. E. Yeomans, Commandant of the 12th Naval District, turned the first shovelful of earth at the cyclotron site, approximately one block southwest of the main Laboratory building. Invited guests present included Congressman William S. Mailliard; the Executive Assistant to Congressman John F. Shelley, Eneas Kane; the President of the San Francisco Chapter of the Navy League, James Grealish; and the SFNS Commander, RADM C. A. Curtze; Ralph V. and Hans Larsen, contractors for the building; William Willis, Executive Vice-President of William M. Brobeck, Architects, who designed the building and the facility; Robert Avery, Project Manager from Brobeck; and William Crozer, 12ND Public Works Department, who has control of construction. (See Organizational Changes, page 9, Technical Accomplishments, page 11, and Publicity, page 49.)

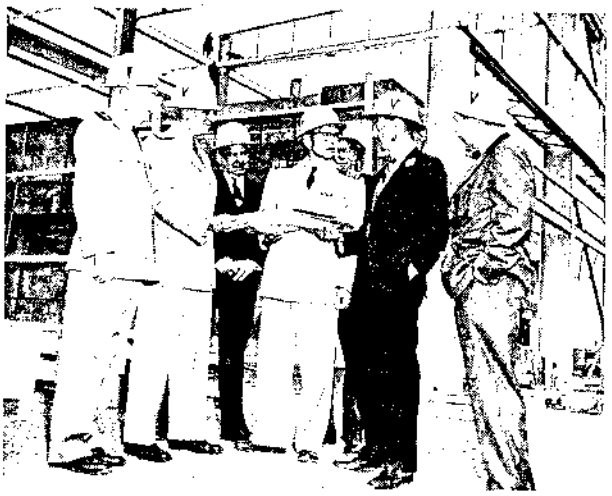
EXCELLENT INSTITUTION

The U. S. Naval Radiological Defense Laboratory is an excellent institution that could well serve as a model for all Service laboratories, according to the Pollack Committee of the Institute for Defense Analysis. On request of the Department of Defense in 1962, this group, headed by Dr. Herbert Pollack, conducted an examination into the performance of 12 biomedical in-house laboratories of the DOD. These investigators further stated in the report (received in 1963) that NRDL "has a clear-cut mission broad enough and challenging enough to attract and retain good scientists. It has a high proportion of civilian scientists who speak with authority on the operation of the Laboratory. It has close associations with large universities that are nearby..."

BETTER CONTACT WITH FLEET

Under the new Commanding Officer and Director, CAPT D. C. Campbell, NRDL initiated a strong push to get better acquainted with Fleet problems so as to insure proper direction and responsiveness of the NRDL Technical Program. Two preliminary meetings were held with Fleet Commanders in anticipation of further contacts at lower organizational levels. On 17 October, Vice Admiral P. D. Stroop, USN, COMNAVAIRFORPAC, visited the Laboratory; and on 24 October a meeting was held with Vice Admiral J.T. Hayward, USN, COMASWFORPAC.

GROUND BREAKING CEREMONY -- On 6 February 1963 the Commandant of the 12th Naval District, RADM E. E. Yeomans spoke briefly before turning the first shovelful of earth at the site of the $3 million NRDL cyclotron. He is being assisted by The Honorable William S. Mailliard, Congressman from San Francisco's 6th District. Looking on are (from left) Dr. E. P. Cooper, Scientific Director; CAPT E. B. Roth, at that time the C. O. and Director; and RADM C. A. Curtze, at that time Commander of the San Francisco Naval Shipyard.



WELL UNDER WAY -- on 8 August 1963 RADM L. D. Coates (2nd from left) Chief of the Office of Naval Research, visited the cyclotron site, accompanied by CAPT J. W. Jockusch (far left), C. O. of ONR, San Francisco, and Dr. Elliot Weinberg, Scientific Department Head, ONR, San Francisco. Showing them around are (from left) Dr. E. P. Cooper, Scientific Director; CAPT D. C. Campbell, C. O. and Director; Dr. E. R. Tompkins, Associate Scientific Director; and Dr. W. E. Kreger, Head, Nucleonics Division.

$8,000,000 BUDGET, $14,000,000 INVESTMENT

The Comptroller and Management Engineers Office reported at the beginning of Fiscal 1964 that NRDL had 599 persons on board including 526 civilians and 73 military personnel plus 76 summer students. Fiscal '64 funding from 12 sponsors ran slightly over $8,000,000.

It was also announced that the estimated worth of the Laboratory in 1963 had reached a figure of $14,000,000. This included $8,000,000 for the main building 815, $4,000,000 for the total equipment, including the new cyclotron facility, and $2,000,000 for the NRDL facility at Camp Parks near Pleasanton.

INITIAL CONTACT WITH U. S. ARMS CONTROL AND DISARMAMENT AGENCY

The Nuclear Test Ban Treaty signed on 7 October presented the United States with a number of problems of control and how far to go in further treaty negotiations. Many of the problems have the same technical base as the fallout studies and other nuclear research at NRDL. As a consequence, and as an endeavor to develop added sponsorship, Laboratory representatives had several exploratory conversations with ACDA officials. On 17 October, Mr. Robert S. Neasham, ACDA consultant, conducted a briefing of NRDL employees on the overall ACDA Cloud Gap Program. On 21 October, the NRDL Commanding Officer and Director, CAPT Campbell, visited Dr. Herbert Scoville, Jr., and Dr. George Rathijens for discussions of NRDL capabilities and programs of possible interest to the ACDA Bureau of Science and Technology. On 22 October, CAPT Campbell and the Scientific Director, Dr. E. P. Cooper, met with Vice Admiral E. N. Parker, USN, Chief ACDA Weapon Evaluation and Control Bureau, for further discussions.

LEADERSHIP

CAPTAIN CAMPBELL COMES ABOARD

CAPT Donald C. Campbell, USN, returned to NRDL on 8 July 1963 to become the ninth officer to head the Laboratory and the sixth to bear the title Commanding Officer and Director. Since leaving NRDL in 1959, CAPT Campbell was at the Bureau of Ships where he headed the Laboratory Management Section.

A second generation "Native Son," CAPT Campbell was born in Pasadena, California. He attended the California Institute of Technology, majoring in mechanical engineering. Upon graduation in 1941, he was commissioned in the Navy. After reporting to NRDL in 1955, during the first year he was at Albuquerque, N.M., at Field Command, AFSWP (now DASA), and in the Marshall Islands as Director of Program 2. In connection with this work, he received a commendation for "his leadership, background knowledge in nuclear radiation and experience that enabled him to perform an outstanding task and contribute materially to the fund of knowledge related to fallout effects..." The balance of the time until he went to the Bureau of Ships, CAPT Campbell was military staff assistant to the Scientific Director and Senior Program Officer representing BuShips. CAPT Campbell is married to the former Janet Partch of Pasadena. They have four children.

Captain Roth Retires

The Commanding Officer and Director since 19 July 1960, CAPT Eli B. Roth, USN, retired from the Navy on 30 June 1963. He went to work in the R and D Management Sector of Allison Division of General Motors Corp., Indianapolis, Indiana.

CAPT DONALD C. CAMPBELL, USN
Commanding Officer and Director

CAPT PAUL F. DICKENS, JR., (MC) USN
Radiological Medical Director

CDR THOMAS L. BIRCH, USN
Administrative Assistant
to the C. O. and Director

OTHER MAJOR PERSONNEL CHANGES

CIVILIAN

There were no changes in Division Heads during 1963. Robert C. Lilly, Assistant Scientific Director, was appointed also as Assistant Deputy Employment Policy Officer for NRDL. In this capacity he will work directly with the Deputy Employment Officer, CAPT D. C. Campbell, on matters relating to employment opportunity without regard to race, creed, color or national origin.

MILITARY

RADIOLOGICAL MEDICAL DIRECTOR

CAPT Paul F. Dickens, Jr., (MC) USN, Commanding Officer of the Naval Medical School at Bethesda, Md., for the past year, replaced CDR M. O. Greaney, Jr., (MC) USN, who retired on 1 November 1963 after a 21-year Navy career. CDR Greaney is now Associate Medical Director of the Syntex Laboratories in Palo Alto, California.

OTHER OFFICER ASSIGNMENTS

LCDR T. J. Johnson, USN, relieved LCDR J. W. Ingalls, USN, as Security Officer, when he retired. Later in the year LT Audrey Gray, (W) USN, reported aboard as Security Officer; and LCDR Johnson relieved CDR Gale Bergey, USN, as Administrative Director so that CDR Bergey could devote full-time to being Officer-in-Charge of the Radiological Control Team and C. O.'s representative at Camp Parks. In December, preparatory to CDR Bergey's retirement early in 1964, LCDR Johnson also assumed his duties at Camp Parks.

The Radiological Health Officer, LCDR C. H. Brown, (MC) USNR, completed his Navy career. For the next year he will be a civilian at the University of California Medical Center, Department of Medicine, on a National Institutes of Health Fellowship, doing research on thyroid pathophysiology. He was replaced at NRDL by LT Frank McKnight, (MC) USNR.

LT R. L. Martin, USN, shifted from Biophysics Branch to Head of Pathology Service, relieving LCDR William Foley, USNR, who became a civilian again and returned to the University of Minnesota Medical School to teach in the Department of Pathology. Two new investigators in the Cellular Radiobiology Branch, LT Gerald Hanks, USNR, and LT Theodore Phillips, USNR, and CDR Doris Cranmore, (W) USN, a NRDLer from 1955-60, joined the Laboratory scientific investigative staff.

CDR Louis Wachtel, MSC, USN, came aboard and was assigned to Experimental Pathology Branch. Leaving that Branch was LT W. D. Skidmore, USNR. Although still in the Service, LT Skidmore will attend the University of California Medical School (Department of Biochemistry) during the next two years, working for his Ph. D.

Leaving the service were: LT R. A. Rockwell, USNR, Accelerator Branch, who is now attending Dental School at Washington University in St. Louis, Mo.; LT John Connolly, USNR, Applied Research Branch -- in Graduate School, Physical Chemistry Division at Brandeis University, Waltham, Mass.; and his wife, LTJG Elaine Connolly, (W) USNR, of the same Branch, now a full-time wife and mother.

Capt. Norbert Page, USAF, relieved Capt W. G. Wisecup as the Air Force Program Officer and veterinarian in the Cellular Radiobiology Branch. Capt. Wisecup, still in the Service, is attending the University of California for two years working on his Master's degree in physiology...Capt. John Clatworthy, USMC, replaced Lt. Col. Floyd Vuillemot, USMC, who is now Engineer, 3rd Marine Division, Fleet Marine Force, Pacific. Maj. James Maloney, USA, OCE Liaison Officer, was transferred to Heidelberg, Germany, as Deputy Engineer Operations Officer. He was replaced by Capt. Eugene Beckett, USA, who subsequently resigned from the Army leaving the billet vacant at the moment. 1st Lt. James F. Taylor, VC, USA, replaced Captain O. D. Blanchard, Jr., VC, USA, as Head of the Veterinary Medical Service. Capt. Blanchard (still in the Service) will attend Stanford full-time, working for his M. S. degree in biological science.

MILITARY/SCIENTIFIC TEAMWORK STRESSED

On his first military inspection at NRDL, CAPT Campbell invited the Scientific Director, Dr. Cooper, to accompany him. This was the first military inspection in which a civilian scientific management member had participated. CAPT Campbell stressed that his invitation emphasized that NRDL represented a single team effort and not a Laboratory composed of separate military and civilian groups. "While there are some differences in regulations and laws governing these groups," stated CAPT Campbell,

"they are highly dependent upon one another and mutual cooperation and understanding are essential to the successful accomplishment of our goal."

NRDL MISSION RESTATED

During 1963 there was no change in NRDL's mission which is: To conduct basic and applied research on nuclear and thermal radiation from nuclear explosions, natural and controlled processes, and nuclear accidents and incidents, including chemical, physical and biological processes and effects, associated phenomena and dispersion and contaminating effects of radioactive materials; to develop and evaluate radiac devices and systems, shielding equipment and materials, medical countermeasures for modification of the biological effects of radiation, and reclamation and decontamination procedures and countermeasures; to conduct composite evaluations of nuclear situations, including inter-related effects such as blast and shock; to prepare data for technical and operational manuals and training; to develop use of radioisotopes and other tracer techniques in the above technological and scientific areas; and to assist all of the military services, other federal agencies, and Government contractors in assigned areas.

ORGANIZATIONAL CHANGES

The chart on page 10 shows graphically the organization of NRDL as of 31 December 1963. It will be noted that only one permanent change occurred during the year. The name of Code 942 was changed from Instruments Branch to Radiation Electronics Branch (NRDLINST 5450.3 CH-19 31 January 1963) to more accurately reflect the objectives of this Branch which are to: (1) Determine specifications of the military radiac systems which are needed to meet performance requirements dictated by operational usage; collaborate with Military Evaluations Division in studies leading to performance requirements; develop apparatus and standards for guiding radiac development, procurement, testing, and usage. (2) Conduct suitability and acceptance tests on radiac systems in the Laboratory and at field sites. (3) Conduct an electronic research program designed to provide advanced components and circuits and to utilize newly discovered phenomena. (4) Plan, schedule, design, develop, and engineer electronic systems

as requested by sponsoring agencies and as required by the Laboratory's technical program. (5) Determine the effects of, and propose remedial measures for the effects of, radiation environments on electronic components and systems. (6) Develop techniques, conduct investigations, and establish requirements for scientific and engineering facilities essential to fulfill the above functions.

CYCLOTRON COORDINATOR'S OFFICE ESTABLISHED

A temporary change was made in the Laboratory organizational structure establishing the Office of the Cyclotron Coordinator, Code 180. This office is intended to handle all matters relative to the construction and placing in operation of the Neutron Radiation Facility. CDR F. J. Kilgore was named to head the office with Dr. H. A. Howe as Technical Director.

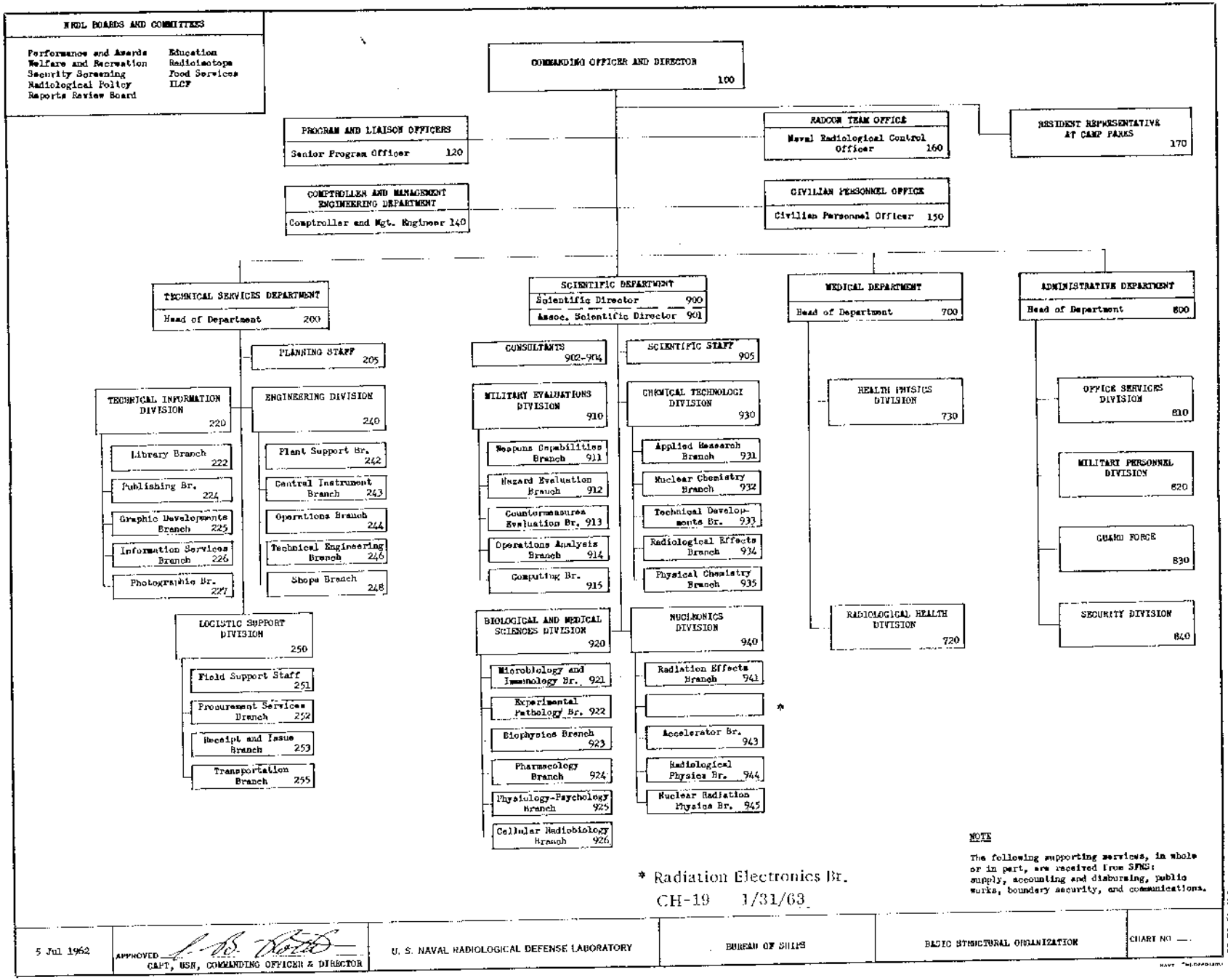
COMMANDING OFFICER ISSUES NEWSLETTER

Shortly after Captain Campbell reported aboard as Commanding Officer and Director, he instituted preparation and distribution of a newsletter to be distributed to the Commandant, 12th Naval District and to key codes in the Bureau of Ships and Bureau of Medicine and Surgery.

The newsletter reports briefly and informally on highlights of the month and is distributed before the 15th of the following month. Expressions of appreciation for this "quickie" report on NRDL events of interest to higher authority were expressed by the recipients.

RECORD SET ON INVENTORY

The annual inventory of the Ready Supply Store (formerly requiring four to six weeks) was commenced on 19 November 1963 and completed in the record time of five days. The physical count of the 2,500 stock items was accomplished with the assistance of 15 enlisted personnel obtained on loan from the Billing Office of Treasure Island. With the mechanization of the stores records, tabulation of the inventory was accomplished on the 704 Computer.


NRDL BOARDS AND COMMITTEES
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Welfare and Recreation
Security Screening
Radiological Policy
Reports Review Board
Education
Radioisotops
Food Services
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NOTE
The following supporting services, in whole or in part, are received from SPNS: supply, accounting and disbursing, public works, boundary security, and communications.
* Radiation Electronics Br.
CH-19 1/31/63
5 Jul 1962
APPROVED
CAPT, USN, COMMANDING OFFICER & DIRECTOR
U. S. NAVAL RADIOLOGICAL DEFENSE LABORATORY
BUREAU OF SHIPS
BASIC STRUCTURAL ORGANIZATION
CHART NO —
NRDL-TR-65-95

CHAPTER II -- TECHNICAL ACCOMPLISHMENTS

The following brief discussion of selected scientific activities at NRDL during 1963 represents accomplishments and provides a cross-sectional view of the research program.

MAJOR NUCLEAR RADIATION SOURCES

COBALT 60 SOURCE RANGE AT CAMP PARKS

The most important completed addition to NRDL's radiation source capacity during the year was the 15,000 curie, Cobalt 60 gamma ray facility at Camp Parks. This source, described in detail in the 1962 history, is located in a small valley, largely surrounded by hills several hundred feet higher than its own level. It is being used for long-term experimental animal exposures as well as complex geometrical configurations for shielding studies, plus developmental radiac systems studies requiring actual radiation field environments.

70" CYCLOTRON BUILDING COMPLETED

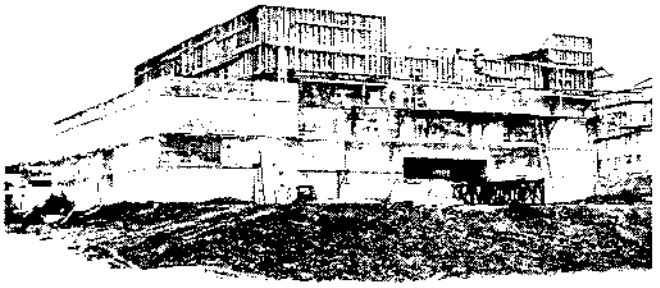
The development of the Laboratory's major radiation source facility, the new High Flux Neutron 70-in. Cyclotron, progressed rapidly with building construction completed late in the year. Contracts for the main magnet core, coils and power supply, which together constitute the most crucial part of the cyclotron construction, were consummated near year's end. Considerable design work preceded the final determination of the bid package. This work included the establishment of magnet pole face parameters by NRDL personnel using the results of Model Magnet data interacting with computer codes that simulate particle orbits. When the cyclotron is completed in 1966, NRDL will possess a capability for the production of a variety of particles and energies including:

(1) Protons with variable energies over a range of 20-70 MeV and temporary adjustments to 105 MeV;

(2) Deuterons from thermal to 35 MeV and to 55 MeV in a special configuration; and

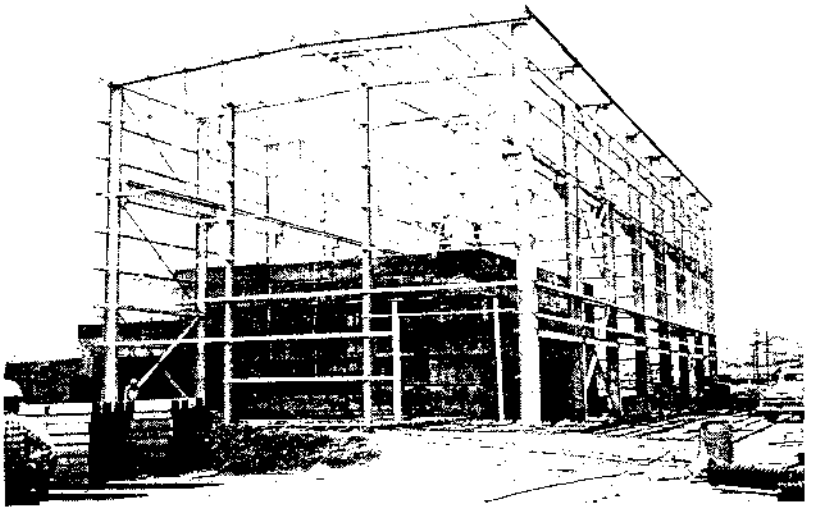
NRDL CYCLOTRON BUILDING

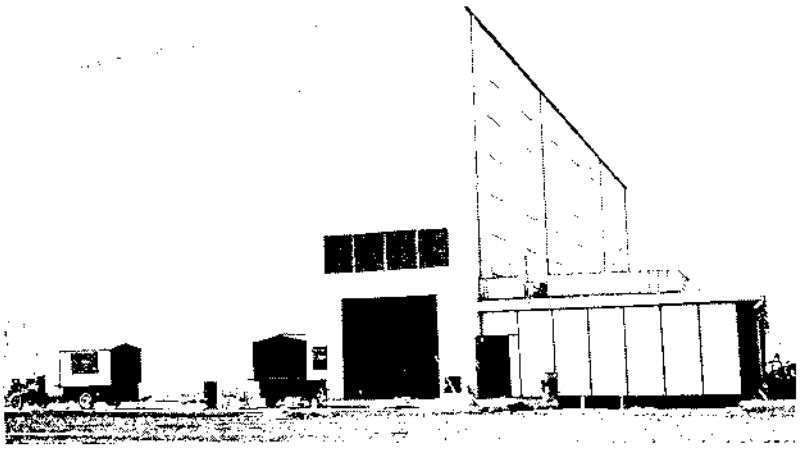
Under Construction



1 July 1963

9 August 1963





29 November 1963

(3) Alpha particles up to 100 MeV. Fluxes up to 10^{15} neutrons/sec. will be possible under certain operational conditions and will give NRDL a unique position for producing high levels of relatively pure neutron radiation fields.

The Cobalt 60 source at Camp Parks and the Cyclotron Facility supplement other sources which include the 2-MeV Van de Graaff, the 150 KeV Electrostatic Accelerator and a variety of X-ray machines, ranging in energy up to 1 MeV.

WEAPONS TESTS PROJECTS CURTAILED

As in previous years, a large area of investigation at NRDL was concerned with nuclear radiations from weapons and their effects. Although the Nuclear Test Ban Treaty late in the year halted gathering of effects information directly from weapons test data, NRDL, having been prepared for such an eventuality for the past several years, continued this program by simulating weapons radiations with its various radiation sources, both at Hunters Point and at Camp Parks.

Weapons test activity was limited to Operation ROLLER COASTER, Project 2.6A; Operation FERRIS WHEEL, Project 2.9 was in the field but was cancelled as a result of the Nuclear Test Ban Treaty. Technical Reports (PORs) for Shot SMALLBOY 2.9, 2.10 and 2.11 and Shot JOHNIE BOY, Project 2.9, which were part of Operation SUNBEAM conducted in 1962, were completed and sent to the sponsor for publication.

PROJECT ARNE (AERIAL RECONNAISSANCE OF NUCLEAR EXPLOSIONS)

NRDL, utilizing the airborne multisensor capabilities of the U. S. Army Research and Development Command and Project Michigan of the University of Michigan, conducted an investigation of the feasibility of using advanced sensor aerial reconnaissance equipment, conventional photographic equipment, infra-red imagery equipment and side-looking airborne radar to rapidly detect, locate the origin, and assess effects of underground nuclear explosions. In support of this priority effort for the Advance Research and Projects Agency of the Office of the Secretary of Defense, ARNE personnel participated in Project SHOAL, a nuclear event detonated 1200 feet underground near Fallon, Nevada, on 26 October 1963. This participation provided additional information to that obtained during the Suffield Experimental Station 20-ton high-explosive detonation in Canada in August.

HYDRA

A product of an earlier moratorium on nuclear weapons testing was the HYDRA Program at NRDL. Significant results from this program were

forthcoming during 1963. An analytical model of the underwater nuclear explosion bubble was developed by the Armour Research Foundation under contract. This model describes the growth of the bubble to the first maximum expansion as a function of yield and depth of detonation and provides a description of the thermal dynamic state of the bubble interior at its maximum. Also under the HYDRA Program, experimental work involving the sampling of explosion products within an underwater migrating bubble was completed, using an activated exploding gold wire. Sampling of the products from the exploding wire were successful, both from the bubble volume and its first and second maxima. For the first maximum, preliminary results indicated accountability of the total amount of gold that had been introduced with the majority of the products remaining in the inner volume of the bubble. This agrees well with the nuclear bubble theory.

A theoretical model describing the physics of the base surge of an underwater burst was also completed. This model describes the surge dynamics as a function of yield, depth of burst and depth of bottom over a range from 100 lbs. TNT to 30 KT TNT equivalents. The areas and times of rainout and the liquid water content of the base surge are predictable and excellent agreement was found with the limited data available from nuclear tests.

Preliminary designs were completed for instrumentation to sample the gaseous liquid water and radio-nuclide fractions of base surges from nuclear bursts. Also, a short range prototype rocket system was developed and tested for obtaining radiation data in and about the plumes from underwater nuclear explosions.

HYDRA IIB STUDIES

Under the HYDRA IIB Program, studies concerning the flow of liquid about the underwater bubble, internal structure of the column and the transfer of explosion products to the column came up with the following tentative results:

(a) Charge Depth (inches)	Sampling Height (ft)	% of Tracer in Column
1.6	8	5.4
2.5	8	3.9
3.5	6	3.8
5.5	6	0.1
7.5	6	0.02

(b) At charge depths of interest the tracer was found to be associated with the convergent jet rather than the column crown. Also, over half of the quantity of tracer was collected between 100 msec (time of maximum bubble diameter) and 300 msec.

(c) Measurements of gamma dose rate were made at levels of 2 to 12 ft above the water surface with a narrowly collimated gamma detector mounted adjacent to the column. Preliminary analysis of this data shows a high dose rate during an initial 10-20 msec period with the detector at low heights, but an abrupt drop of dose rate was observed as the detector was raised to elevations above 6 feet. Indications are that the detector "sees" the radioactive tracer within the explosion product bubble during its early expansion above the surface.

Also a very low dose rate was observed when the detector was located at the 12 ft elevation where it is adjacent to the column crown resulting at the shallower charge depths. This is consistent with sampling data which show that only a small fraction of the tracer is transferred into the column.

PROTECTION AGAINST NUCLEAR WEAPONS AND RADIATIONS

VULNERABILITY OF SHIPS IN THE NUCLEAR ENVIRONMENT

Two studies were conducted on the subject of ship and fleet vulnerability to the effects of nuclear attacks. The first was a study of the Destroyer Escort (Guided Missile) Shipboard Toxiological Operational Protective System (DEG STOPS), and the second a study of fallout effects to ships of the Western Pacific (FESWESPAC). DEG STOPS is a DEG of special design to maximize its operating capability in a nuclear, biological and chemical warfare environment.

In the DEG STOPS study particular emphasis was given to the significant ionizing-radiation effects for air, surface, and underwater bursts. Recommendations were made for improved nuclear warfare readiness procedures, pointing out the requirements for timely and effective collection, display, and evaluation of nuclear weapons effects data for command and control of forces.

The DEG STOPS study was similar in concept to an earlier CVA-67 study (see 1962 history), but examined more fully the shielding capability of the STOPS since the smaller ship provides considerably less protection to nuclear weapon radiation effects. The study recommended ship designers

take maximum advantage of inherent ship shielding to locate vital control stations in the best shielded locations compatible with operational requirements.

The FESWESPAC study was a comprehensive analysis of the expected fallout effects to fleet operations of WESPAC resulting from a large scale nuclear attack on land targets. Maximum expected ship traverse doses through fallout by monthly periods, ship speed, and range from single and multiple weapon bursts on target complexes were computed and tabulated by means of a correlated model of ship movement and fallout. Maps of expected fallout zones were developed.

Improved Doctrine for Ship and Fleet Nuclear Warfare Readiness

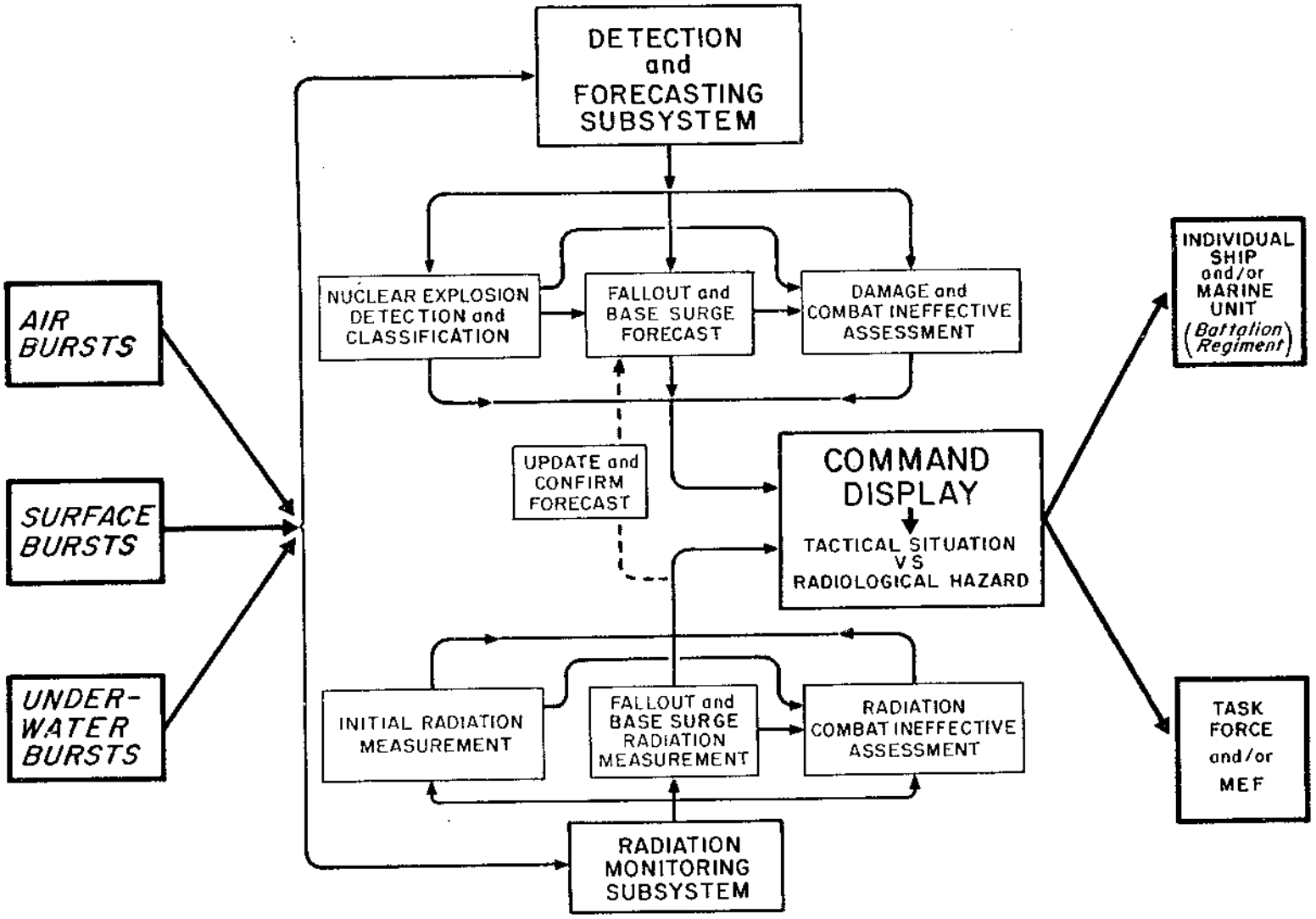
The continuing analysis of ship and fleet nuclear warfare readiness resulted in the further development of doctrine and exercises to improve shipboard nuclear offensive and defensive capabilities. The improved doctrine updated the nuclear warfare material in the naval warfare publications NWP 32 (A) Anti-Air Warfare, NWP 50 (A), Shipboard Procedures and NWIP 50-1 (A) Battle Control. Significant consequences of nuclear weapon effects to naval ships and ship operations are described in the doctrine which also recommends procedures for collecting, evaluating, displaying and disseminating data on radiological effects, and for controlling radiation hazards. Improved exercises and umpiring procedures, prepared for the Navy publications FXP 3-2, Preparation, Conduct and Analysis of a Battle Problem and FXP 5, Conduct of Fleet Exercises, provided ships and fleets with a means to exercise and judge their readiness condition.

NEWRADS (Nuclear Explosion Warning and Radiological Data System)

NEWRADS was developed to provide Navy and Marine Corps commanders with the significant initial and residual nuclear-weapon-effects information necessary for control of their units in multiweapon nuclear environment. This system consists of sensors, procedures, computational programs and the associated hardware to provide the significant nuclear-weapon-effects data in relation to Navy and Marine Corps tactical situations. The processing of this information is to be accomplished to the greatest extent possible, with current or programmed communication, computation, and display equipment.

NEWRADS consists of two subsystems: (1) Nuclear Detection and Radiological Forecasting (NUDET-RADFO) Subsystem and (2) Radiation Monitoring (RADMON) Subsystem. These subsystems will be capable of independent as well as combined operations.

For offensive use the NUDET-RADFO Subsystem should provide facilities and procedures for commands to interrogate the system in order to determine the damage and radiological effects of a selected weapon yield, burst height, and location against targets of opportunity and/or forces of concern.



NEWRADS Operational Diagram - Basic Functions Necessary for Multiweapon Nuclear Warfare Operations

The RADMON Subsystem should provide unit and force commanders with initial and residual radiation dose and dose-rate data suitable for the assessment and control of radiation exposure of personnel. The RADMON equipment should provide suitable measurements and displays for local (i.e., ship vital control stations and marine elements) and for large area (i.e., ship, task force, battalion, and regiment) evaluation and control. Design of the RADMON part of the system was undertaken.

Target Vulnerability Studies

A computer model was designed which will accept facility and personnel data in a standard form for any installation, apply a wide range of nuclear attacks and compute the required estimates of damage to buildings, equipment and other resources. The model will also determine the period of recovery, the mission entry time and the number of survivors from these attacks. The model will be used in two general ways: (1) a wide range of attacks will be computed for each shipyard, and a book of tabulated results will be assembled for use of both Bureau of Ships personnel and shipyard Disaster Control Planners and (2) the computer model will be used for further study for the Bureau of Ships and for after-the-fact assessment of nuclear attack results.

Development of ASW Doctrine for the Nuclear-Depth-Charge

A study pertaining to naval operations was the development of delivery ship standoff doctrine for the employment of nuclear-depth-charges. This study includes analyses of the significant underwater-effects of nuclear depth charges, with proposed standoff range for avoiding these significant effects. Assistance was provided OPTEVFOR in defining the significant effects of nuclear depth charges for use in their publications.

Three other studies related to the ASW doctrine were in progress. They consist of:

(1) A convenient method for displaying the ship standoff ranges from underwater nuclear bursts.

(2) Employment of nuclear-depth-charges in the vicinity of other friendly naval ships.

(3) ASW maneuvers in the area surrounding surface zero following underwater-nuclear-bursts.

SOIL RADIOACTIVITY PROTECTION

Another research output of considerable interest to the Armed Forces was a method of predicting soil moisture content in the top soil layer-of-interest in a limited area around ground "0" where a tactical nuclear

weapon has been detonated high enough so that no radioactive fallout occurs. In such a situation radiation hazard state exists because of the gamma radiation emitted by the radioactivity induced in certain soil elements by the neutrons emitted in the detonation. High moisture content results in less attenuation of resulting gamma radiation by the soil. The NRDL-developed method will be applicable to most soils in the world and its tactical applicability can be readily extended when and if further data becomes available.

SHIPS AS FALLOUT SHELTERS

A major scientific investigation completed for the OCD had to do with various ways in which "mothball" fleet and other ships might be used as fallout shelters and ships' utilities made available for use by shore installations in a nuclear attack situation. It was estimated that with sufficient warning, merchant ships and boats could evacuate up to 12,500,000 persons from target areas. Naval Reserve Fleets could handle another 500,000 persons. Further, at a cost of about $90 per occupant, 800 of Liberty Maritime Administration Reserve Fleets (currently being scrapped at the rate of 50 per year) could be converted into shelters accommodating an additional 8,000,000 persons. For the post-attack situation, ships could serve as headquarters, hospitals, living quarters, store houses and prime producers of electrical power and potable water.

SHIELDING FROM NUCLEAR WEAPONS RADIATIONS

The shielding effectiveness of structures is different for the different types of weapon radiations (initial, transit, and fallout). The goal of the shielding program is to develop a technology for predicting the shielding effectiveness of structures for each type.

The technology for fallout radiation is the most advanced. A method now exists for predicting the shielding effectiveness of quite complicated structures in a fallout field. Experiments to test various aspects of this technology were completed. These included fundamental experiments on simple slab configurations, using point and simulated gamma-ray sources, and tests on simple compartmented structures in real fallout fields.

The tests of the fundamental aspects of the theory, in general, showed good agreement and substantiated many of the basic assumptions of the theory, but analysis of the weapons test data raised some important questions regarding the fallout technology. The NRDL experiment, conducted

in 1962, was more complete, both in scope and in detail, than any previous shielding experiments in the field. Gamma-ray spectra, angular distributions, and ground roughness effects were measured in addition to shielding factors. Shielding factors were obtained for compartmented structures, and the barrier attenuation factors for slabs corresponding to the structure wall thickness were measured directly. The extensive analysis of this data, underway in 1963, should pinpoint the causes of any discrepancies between the observed and predicted shielding effectiveness.

RADIATION ANGULAR DISTRIBUTION MEASURED

A set of fundamental measurements of the angular distribution of radiation scattered from a plane concrete surface was obtained during the year. The data serve as a check of the Monte Carlo programs to be used for calculating shielding in complex structures. Significant differences between the experimental and theoretical results indicated that some refinements in the Monte Carlo programs are needed.

TRANSIT MEASUREMENT METHOD SUCCESSFUL

Transit radiation is one of the more important problems that the Navy is apt to encounter in combat employing nuclear weapons. Fallout can often be disposed of by ship washdown systems, but transit clouds of radioactive material can deliver large doses of radiation to ships. 1963 research results provided a method for calculating the shielding effectiveness of ships against transit radiation, based on experiments run with a Co^{60} source on a ship at the San Francisco Naval Shipyard. The results showed excellent agreement with data obtained at weapons tests.

NEW INFORMATION ON SOURCES OF WEAPON RADIATIONS

A number of types of laboratory investigations gave better information during the year on the nature of the nuclear radiations following a nuclear weapon detonation and the methods of formation of these radiations and their sources. The initial nuclear radiation from weapons consists of both neutrons and gamma rays and is produced by a number of different mechanisms. Direct measurement of the characteristics of initial nuclear radiation from nuclear weapons is extremely difficult because of the short-time over which it is delivered. However, much new knowledge about the characteristics of this radiation was obtained from computer calculations and related Laboratory experiments.

NEUTRON ENERGIES STUDIED

Studies were conducted to determine the characteristics of the initial gamma radiation produced by inelastic scattering of neutrons from

elements in air, steel and water and the relative importance of each. These data serve as in-put to Monte Carlo calculations of the initial radiation fields. Nitrogen, oxygen and silicon were the first elements to be studied. The NRDL 150-keV electrostatic accelerator, which can produce large fluxes of either 2.8 MeV or 14 MeV neutrons was used as a neutron source. A preliminary measurement of the production of gamma rays by 2.8 MeV neutrons was made. The only important contributor was found to be the 1.8 MeV gamma ray from the first excited state of Si^{28}. Neutrons of 2.8 MeV energy did not produce significant numbers of gamma rays from nitrogen or oxygen. The 14 MeV neutron measurements, most recently underway, required more elaborate shielding because of the higher background of radiation associated with them. The experimental apparatus was modified to make feasible the 14 MeV neutron measurements. Future work will include other elements and a wider range of neutron energies. The NRDL 2-MeV Van de Graaff and NRDL 70-inch cyclotron will be used as neutron sources.

HIGH TEMPERATURE CHEMISTRY GAINS

The distribution of fission products following a detonation depends upon the chemical processes that occur in the fireball. To study these processes requires the use of high temperature chemistry, which is gaining a prominent position in the chemical studies at NRDL. In measurements of the distributions of $Eu^{152,154}$ and Nd^{147} as functions of exchanger compositions for molten sodium borate-exchangers in contact with molten NaCl, a separation factor of about 1.9 was achieved. A report was started on the distributions of alkaline earths and rare earths in this exchanger system. Equilibrations of Na^{22} -labelled, molten sodium borate exchangers with molten KCl at various exchanger compositions conclusively demonstrated that ion exchange occurs in these systems.

NEW TIN RADIONUCLIDES DISCOVERED

The continuous evolution of stannane from a solution of U^{235} undergoing neutron irradiation followed by collection of the decay products of fission product tin on a charged wire led to the discovery of two and perhaps three new tin radionuclides. Sn^{133} was found to have a 43 second half-life (in agreement with the 39 second value found by a different technique). Sn^{134} was found to have a half-life of about 10 to 20 seconds. Evidence was also obtained for the existence of Sn^{135}, although it is very short-lived.

SYSTEM FOR SOLVENT EXTRACTION SEPARATIONS

A system was constructed for the continuous extraction of selected elements by a water-immiscible solvent from an aqueous solution undergoing

irradiation. A very few seconds is required to remove most of a particular species to a separate container. This system should be applicable to a wide variety of solvent extraction separations. A rapid radiochemical separation procedure was developed for iodine.

CALCULATIONS ON EARLY TIME FISSIONS IMPROVED

In the calculation of abundances of short-lived fission products, the largest errors occur in the region of high independent yields at closed nuclear shells. Mass chains 131,132 and 133 include closed shells of 50 protons and 82 neutrons. Any effect of the closed shells on independent yields by displacement of the most probable charge for each mass chain should be noticeable in these mass chains. Therefore, independent fission yields were determined for several members of these mass chains in thermal neutron fission of U^{235}. No significant displacement of the most probable charge from the expected values was observed. This unexpected result, if confirmed by additional measurements in this and other shell regions, will indicate that closed nuclear shells have little or no effect on the abundance of products formed independently in fission. A possible explanation is that the fission fragments are formed in highly excited levels where spacing between energy levels is small. Then the fact that the ground level at closed nuclear shells is quite low would not lead to the favoring of these widely spaced lower levels in the fission process itself. Calculations of abundances of fission products at early times after fission should be significantly improved with this knowledge.

MACHINE PLOTTING OF SPECTRA

Physical constants of beta-emitting fission products were collected and tabulated and the 704 computer programmed to accept this information and calculate the composite beta-spectrum of each nuclide. These spectra are stored in a library on magnetic tape. Other programs call for arbitrary mixtures of fission products and output the resultant composite energy spectrum. Provision is made for specifying the width and sampling frequency of the desired spectrum. The mixture of beta-emitters can be specified directly, or by reference to a set of calculated abundances from the decay analysis program system. Provision will shortly be made for machine plotting of the composite spectrum and the spectra of its components.

BIOLOGICAL RESEARCH

One of the primary ultimate purposes for getting information about nuclear radiations is to be able to use this information in judging its

effects on humans. To help solve this problem a considerable research effort at NRDL continued to be expended on problems concerned with effects of nuclear radiations on biological systems.

ROLE OF RNA IN ANTIBODY FORMATION

An important defense mechanism is the formation of antibodies formed by the body in response to the introduction of a foreign substance. Antibodies react not only against infectious agents, but also against other foreign materials such as tissue or organ transplants. Irradiation causes and inhibition of antibody formation and hence makes the irradiated animal more susceptible to infection.

It has been shown that desoxyribonucleic acid (DNA) found in the cell nucleus contains the coded information giving the cell its genetic characteristics. Furthermore, it has been shown that one form of ribonucleic acid (RNA) acts as a "messenger" in transferring this information from the nucleus to that portion of the cell which manufactures the cell constituents. It has also been shown that purified preparations of messenger RNA, if properly presented to "unconditioned" cells, can cause those cells to produce proteins which they ordinarily are incapable of producing. In experiments during 1963 it was possible to transfer the synthesis of a γ globulin, myeloma protein, formed by a mouse plasma cell tumor to normal mouse lymphoid cells.

THE RELATIONSHIP OF RADIATION DOSE-RATE AND RADIATION HAZARD

Employing a method which detects persistent chromosomal aberrations in marrow cells of mice, a striking difference was observed during the year between the effect of high versus low dose rates of ionizing radiation. Thus, clones of cells with chromosome abnormalities were present (12 to 76 weeks after irradiation) in the marrow of all the mice previously exposed to single (500 rad) or fractionated doses (100 rad x 9, daily) of X rays given at a dose rate of 30 rad/min. By contrast, none of the mice exposed to continuous gamma radiation (at a dose rate of 1.45 rad/hour) showed definite clones of abnormal marrow cells. These observations suggested that if the radiation dose-rate is sufficiently low, recovery phenomena occur, even for late sequelae of radiation.

X-Radiation and Carcinogenesis

New insights were obtained into the interaction of X-radiation and carcinogenic chemicals. The induction of lung tumors in mice by urethan is completely suppressed when the animals are exposed to a single lethal dose of X rays (880 rad) followed by bone marrow transfusion to protect against radiation death. It was found that urethan lung carcinogenesis

is characterized by a marked stimulation in DNA turnover in lung cells during the first week after urethan administration, and that radiation-suppression of lung tumor incidence is correlated with inhibition of this early biochemical event.

Studies on the interaction of fast neutron radiation and cell division stimulation in respect to the induction and development of tumors were continued. A marked increase in incidence of liver tumor was observed in mice which received a single subcutaneous injection of carbon tetrachloride one month after neutron irradiation; and an even greater increase in hepatoma incidence was observed when the mice were exposed to fast neutrons one day after carbon tetrachloride injection.

Radiation and Ion Transport

In radiobiological investigations of different ion absorption mechanisms, test tube approaches were devised for measurement of ionic movement in mammalian and plant tissues. Viability of the tissues has been proven, and metabolically active as well as physically passive factors have been differentiated for normal transport of several ions. Measurements of the electrical parameters, double label tracing of ions, and biochemical studies based on substitution, metabolic inhibition and quantitative enzyme characterization were employed experimentally. In other studies, fast neutrons have been shown to be markedly more potent than X rays in inhibiting sodium transport in the mammalian gastrointestinal tract.

Radiation Recovery with Fractionated Exposure

Recent evaluation of new data made it possible to identify two distinct processes of recovery from radiation injury in mammals. One process involved the repair of sublethal injury in irradiated cells, and required less than 24 hours for completion. The other process involved the replacement of killed cells by division of the surviving cells, and requires from one day to several weeks for completion. When radiation is given as a series of sublethal doses, one or the other of the two recovery processes tends to predominate, depending upon the size and time-distribution of the doses, and the predominance of a given recovery process was found to lead to a characteristic rate of accumulation of injury.

These processes of recovery, and the consequences of size and time-distribution of dose, was found to apply not only to acutely lethal injury but also to non-recuperable injury and life-span shortening effects of radiation.

Effects of Radiation on the Nervous System

Studies were devised to detect the most immediate reactions of the nervous system to ionizing radiation. The arousal phenomenon in sleeping

animals was used to demonstrate an immediate perception of X-ray exposure at low dose-rates. One second X-ray bursts, at dose rates in the range of 0.05 r/sec to 3.2 r/sec, are capable of eliciting an awakening reaction in the inactive ophthalmectomized rat. Total body exposure is not essential. A one-second exposure at 1.0 r/sec will elicit arousal with either partial body or head exposure; head exposure, however, proved more effective.

Effects of Radiation on Life Span

With respect to life span studies, male rats were exposed to a single whole-body high sublethal dose of fast neutrons (220 ± 10 rads) at one of five ages ranging from the juvenile to the late adult stages of life. Life span functions for these groups have been compared with those of littermate controls. In terms of the median or mean survival time, life expectancy, age-specific death rate, and survival curve, there was a marked detrimental effect of irradiation in animals exposed at one month of age. This radiation effect diminished progressively when exposure occurred at 3 or 10 months of age, and was no longer discernible in groups exposed at 15 or 21 months. For those age groups (1, 3 or 10 months) which exhibited a significant alteration in life span functions, there was a latent period of seven to ten months before the effect became apparent. Thus, it appears that age at exposure is an important stipulation for consideration of long-term effects of irradiation. Further, it appears that animals exposed to sublethal (acute) doses of radiation after full adulthood has been attained may show little or no alteration in life span functions.

Interspecies Comparison of Recovery

A comparison of recovery from sublethal radiation injury was conducted in several species ranging in size from the mouse to the burro to correlate the recovery rate of the whole animal to that of the blood cell forming tissues. The data indicated that, in general, both the systemic (redetermined LD_{50} at 30 days) and hematological recovery in small animals is rapid, whereas recovery in larger animals is much slower. Furthermore, systemic recovery in all species does not increase logarithmically with time but rather alterations of radiosensitivity have been detected for certain large and small animals after a conditioning dose of radiation.

Radiation Effects on Liver Regeneration

A study concerning the protective effect of deep body hypothermia on X-ray induced mitotic aberrations of regenerating rat liver was completed. The effect of X rays on retardation of growth (body weight) and the number of X-ray induced mitotic aberrations in regenerating rat liver was obviated by deep body hypothermia (+ 1°C). It was concluded that this latter effect was probably due to the extreme anoxic state rather than the concomitant hypothermia.

Effect of High Neutron Fluxes on Mortality

A comparative study was completed of the radiobiological effects of high radiation dose rates of the order of 1 x 10^6 rads/min with that produced at dose rates of 40-100 rads/min. No dependency of the acute mortality response on radiation dose rate was detected in either neutron- or gamma-irradiated mice. Likewise, the acute mortality response of dogs was not affected by neutron radiation dose rate. Also, no effect of dose rate was detected in the frequency of mitotic aberrations in regenerating rat liver, in the efficacy of two radiation-protectants in gamma-irradiated mice, and in patterns of recovery from radiation injury as evaluated by the split-dose technique in neutron-and-gamma-irradiated mice.

Radiation Effects on Synchroncusly Dividing Cells

Dose rate effects on the process of cell division in synchronized, single celled animals also were studies. No effect of dose rate on cell division delay was detected for either reactor neutrons (10^7 r/min vs 10^3 r/min) or for 250 kvp X rays (1,200 r/min vs 250 r/min). However, with the 250 kvp X ray at rates below 250 r/min, the amount of division delay increase with decreasing dose rate until at approximately 60 r/min, cell division was not affected. These findings suggest that, in this rapidly dividing organism, recovery from irradiation damage is faster than its production at dose rates less than 60 r/min. At dose rates between 60 and 250 r/min, complex interactions between the processes of recovery and damage are probably taking place; whereas at higher dose rates, the damage and recovery processes are practically independent.

THE MEASUREMENT OF RADIATION DOSE

The importance of dosimetry in exploring the effects of nuclear radiation can hardly be overstated. Operations of every kind that involve exposure of personnel, equipment, materials, etc., rely on dosimetric measurements to interpret correctly the effects of nuclear environments. Accordingly, the Laboratory pursues a number of programs with the goal of staying in the forefront of this expanding science. Dosimeters consisting of various materials for which the response to radiation is well known have been in use for some years. The main effort in 1963 continued to be directed in two areas: (1) Study of new materials or methods for detecting and measuring radiation, and (2) research on particle interaction with materials, such as neutron and heavy particle effects, with the goal of providing new or improved dosimetric techniques.

Microcalorimetric Dose Measurements of Gamma Rays and Neutrons

Work in this area was directed to providing a calorimetric method for measuring absorbed dosage, that will find application in standardization

of gamma-ray sources, measurement of pulsed beams (e.g., of weapons), measurements in mixed gamma-neutron fields and direct dose measurement in materials used in radiation damage studies. During the year a microcalorimeter was designed to perform at the boiling point of liquid nitrogen (about -380°F). Prototype exposures were made at dose rates in the range 1 to 10 rads/min and it was found that the stability of the prototype satisfied the established requirements. The dimension and the materials to be used in the miniaturized version of the prototype were determined.

Neutron Dosimetry Techniques

Studies continued toward the developing of standards for measurements of neutron flux, spectrum and dose, which are correlated with similar measurements elsewhere and which make possible accurate evaluation of neutron effects. Neutron and gamma ray dosimetry for animal irradiations at a reactor were completed using a lithium fluoride (LiF) thermoluminescent dosimeter. Both "normal" LiF, having a thermal neutron response several hundred times that of its gamma sensitivity, and "depleted" LiF, which is highly insensitive to neutron dose, were used. With the depleted system a direct measure of the gamma dose in neutron fields is possible. The design of a fast neutron LiF dosimeter based on the thermalized component of neutron dose was being investigated.

Dose responses of glass, thermoluminescent and film dosimeters to high energy charged particles (900 MeV alpha and 720 and 35 MeV protons) were also studied. Dosage sensitivity was not observed to decrease except at lower energies. Glass rods and thermoluminescent systems would, therefore, appear to be satisfactory dosimeters for use in extra-terrestrial environments where the radiation is primarily from high energy protons.

Heavy Particle Dosimetry

During 1963 NRDL conducted studies to determine the rate of energy loss (REL) of heavily ionizing particles and neutrons in tissue. Fundamental work on "track structures" in solid state materials is laying the foundation for the development of a heavy particle dosimeter. The medium selected for the analysis of heavy particle "events" is the nuclear emulsion. The grain density of the multicharged ions with high REL's in insensitive emulsions was examined, and a generalized formula derived that expresses the observed grain density as a function of particle velocity and charge, and of emulsion sensitivity.

Performance Characteristics of Operating Radiacs

Studies of the effect of an operator on the radiological performance of radiacs in radiation environments indicated that the average response of military ratemeters in extended fission radiation fields

would be about 25 per cent low. The method of calibration used a point source of radiation without the operator present, thus introducing the discrepancy. Corrective measures are being recommended for each type of radiac.

Self-Normalization of Radiation Meters

NRDL is engaged in studies to provide devices which periodically monitor space radiation measuring equipment and automatically correct for sensitivity changes or drift. During the year it was found that, in the important case of pulse height analysis systems, normalization can be accomplished with the aid of high energy alpha sources permanently fixed to the detector surface or added to its volume.

Radiac Handbook Series

A handbook covering the use, maintenance, and performance of in-service radiacs was started in 1963. The first section prepared was on the AN/PDR-43, a high-rate beta-gamma dose rate meter.

Radiacs Modified for Navy Training

The increased sensitivity of an NRDL-designed modification of the standard military high range AN/PDR-18A radiac will allow trainees to practice metering techniques without exceeding established radiation exposure limits. Because of the limited training with the standard military high range radiacs, trainees do not become proficient in their use. That is, radiation received by trainees in Navy nuclear radiation metering exercises limit the length and type of the exercises that may be conducted. The NRDL design completed in 1963 requires 4 man hours and $30 of materials for implementation and retains all the operating features and appearance of the standard radiac, but indicates exaggerated dose rate readings up to 5/hr for actual dose rates of 500 mr/hr.

Radiac Requirements Studies

A preliminary study of radiological data requirements for aircraft operation was completed, tentatively establishing new data requirements for certain aircraft missions.

The high intensity performance of the IM-143 quartz fiber dosimeter and the DT-60 silver phosphate glass dosimeter was examined to determine their limitations when exposed to probable gamma-neutron environments. To improve fleet readiness, interim recommendations for the use of these equipments will be made.

NON-WEAPON RADIATIONS

Although the research at NRDL on problems associated with non-weapon radiations forms a relatively small fraction of the current total effort, this research effort contains several very important problems. This area of research will probably become much more important in the years to come.

Oceanographic Instrumentation

Progress on underwater detectors received a considerable boost when special instrumentation was designed and installed in the bathyscaph TRIESTE in the attempt to locate the submarine THRESHER. Under the difficult conditions during the search for the THRESHER, the NRDL equipment functioned satisfactorily. The NRDL radiation-measuring equipment is now being reinstalled in the TRIESTE to provide continuing radiation-measuring capabilities.

EVALUATION OF THE RADIATION HAZARDS ASSOCIATED WITH NUCLEAR-POWERED SPACE UNITS

A significant evaluation by the Laboratory of radiation hazards associated with operation of nuclear-powered space units at the Pacific Missile Range aided in the decision to launch the SNAP 9A. This study included estimates of the ingestion hazard in the fish food chain, in the consumption of alginic acid, agar, and ocean kelp that may be contaminated with plutonium as the result of potential sea immersion of auxiliary power units during the early post-launch phase. Another study of calculated activities of U-235 fission products for very short nuclear reactor operation tabulated for very short reactor runs inventories of all radionuclides and will be useful in hazard evaluations of possible accidents in rocket applications of power reactors.

Radionuclide Release to Seawater

In studies aimed at delineation of the potential hazards deriving from the accidental introduction of nuclear power source materials into an ocean, measurements of the rate and extent of radionuclide release from nuclear power materials immersed in seawater were continued. The experimental data from studies of the short term (less than six months) release of strontium activity from titanate fuels showed a decided increase in dissolution rate when an electron beam was impinged directly upon the test specimen. On the other hand, when the specimens were submerged during irradiation to a water depth slightly in excess of the maximum electron range in water, the irradiation had no appreciable effect on the dissolution rate.

CHAPTER III -- PUBLICATIONS

REPORTS AND MEMORANDA

The following types and number of publications were issued in 1963:

U. S. Naval Radiological Defense Laboratory Report (Formal)	4
Technical Reports (USNRDL-TR)	92
Technical Memoranda (TM)	6
Progress Reports (P)	12
Evaluation Reports (ER)	1
Letter Reports	19
Reviews and Lectures (R and L)	10
Total	144

PUBLICATION IN THE OPEN LITERATURE

Nineteen papers and articles by NRDL authors were published in over 12 journals during 1963.

OTHER PUBLICATIONS

Resources and Capabilities of NRDL
Personnel Handbook

The January 1963 issue of PHYSIOLOGICAL REVIEW devoted 100 pages to "Liver Circulation and Function" by Dr. R. W. Brauer, Head, Pharmacology Branch.

Leigh Owen, Technical Developments Branch, is the author of a radiological defense guide USNRDL No. 467, "Radiological Protective Construction" for engineers and architects published by the Laboratory and by the Office of Technical Services, Department of Commerce. The purpose of this handbook is to aid designers in selecting materials, methods of construction, and upkeep procedures for existing or planned structures, to protect against fallout accompanying a nuclear attack.

Dr. C. Sharp Cook, Physics Consultant, had an article on "The Education of a Danish Physicist" in the May issue of the AMERICAN PHYSICS TEACHER. The first issue of this journal was March 1963.

PATENT ACTIONS DURING 1963

Six patents were issued: (1) K. Miller - "Method for Filling and Sealing of Pressure Vessels," Patent No. 3,065,583. (2) A. E. Greendale and M. Honma - "Apparatus for Controlling Combustion," Patent No. 3,107,981. (3) C. R. Schwob - "Determination of Shielding Factors of Complex Structures for the Energy Range of 0.1 to 4.0 MeV," Patent No. 3,097,254. (4) G. A. Work - "Nuclear Radiation Dosimeter Reader Apparatus," Patent No. 3,098,156. (5) G. A. Work and N.A. Marshall - "Safety Device for Industrial Machine Comprising Fluorescence Detection Apparatus," Patent No. 3,109,094. (6) K. Miller - "Gastight Pressure Vessel," Patent No. 3,109,552.

There were five disclosures authorized for filing of Patent Application; six disclosures submitted for processing; and three disclosures under preparation.

CHAPTER IV

AWARDS -- COMMENDATIONS -- HONORS

HIGHEST DOD CIVILIAN AWARD GOES TO DR. ALPEN

Dr. Edward L. Alpen, Head of the Biological and Medical Sciences Division, received the Department of Defense's Distinguished Civilian Service Award -- the highest honor conferred upon civilian employees by the Defense Department. The presentation was made on 2 October 1963 at the Pentagon in Washington, D.C., by Assistant Secretary of Defense, The Honorable Norman S. Paul, following the reading of the citation by the Secretary of the Navy, The Honorable Fred Korth.

Dr. Alpen was cited for "his extraordinary research work in the development of fundamentally new and basic information on the biological effects of ionizing radiation. Dr. Alpen's research findings have had a highly significant impact on basic fleet operating doctrine, on weapons design and on the military operation of all three military departments. Dr. Alpen's resourcefulness and the pioneer nature of his accomplishments, have contributed greatly to this nation's defense program and won recognition at the highest level within the Department of Defense."

Witnessing the presentation were high ranking military and civilian scientists representing each of the Armed Services and including RADM W. A. Brockett, Chief, Bureau of Ships; RADM C. A. Curtze, Deputy Chief, BuShips; RADM E. C. Kenney, Chief, Bureau of Medicine; RADM C. Galloway, Commanding Officer, National Naval Medical Center, Bethesda, Md.; and Dr. Alpen's wife, Wynella, and their daughters, Angela, 11, and Jeannette,7.

This is the second time that a NRDL scientist has received one of the six annual DOD Distinguished Civilian Service Awards. No other Government activity has earned two. The other recipient (in May 1960) was Dr. P. C. Tompkins, Scientific Director from 1951-60 and now Executive Director of the Federal Radiation Council in Washington, D.C.

In June 1962 Dr. Alpen received the Secretary of the Navy's $5,000 Award for Distinguished Achievement in Science, based on his radiological defense doctrines. In his present position as Head of the Biological and Medical Sciences Division, Dr. Alpen was in mid-October this year promoted to a supergrade level, the first at the Laboratory. He was appointed Associate Editor of the "Proceedings for the Society of Experimental Biology and Medicine."

PROUD MOMENT -- Dr. E. L. Alpen receives the Department of Defense Distinguished Civilian Service Award from the Secretary of Defense (Manpower), Norman S. Paul. At left is the Secretary of the Navy, Fred Korth.

BUSHIPS AWARD -- CAPT W. C. Bennett, Jr., USN, Acting Assistant Chief for Research and Development, BuShips, presents CAPT D. C. Campbell with the Scientific Award for 1962.

CAPT CAMPBELL CITED FOR R & D PROGRAM

At the 6th BuShips R and D Council meeting in Washington, D.C., on 22 October 1963, CAPT Campbell was presented "The Assistant Chief of the Bureau of Research and Development Award for Scientific Achievement in 1962." He was selected for this honor on the basis of his performance while Head of the Laboratory Management Section of the Bureau prior to his assignment to NRDL. He was cited for his work which has "resulted in significant improvement in the management planning program and morale of the Bureau of Ships' Laboratories which has enabled them to make 'greater contribution to the Bureau of Ships' Research and Development Program than ever before possible'."

SUPERIOR CIVILIAN SERVICE AWARD FOR SOULE

Richard R. Soule, Chemical Technology Division, on 7 February 1963 received a Superior Civilian Service Award (the highest that a Bureau Chief may grant) in recognition of the manner in which he discharged the demanding duties of Project Officer for HYDRA IIA. (At that time Mr. Soule was in the Radiological Effects Branch; he was later made Acting Head of the Technical Applications Branch.)

"This assignment was a singularly difficult one," the Chief of Bureau of Ships, then RADM R. K. James, wrote, "requiring the highest degree of administrative ability, especially in coordinating the efforts of many organizations and their personnel. The purely technical aspects of the project were formidable in themselves and the combination of the scientific effort involved, together with the equally demanding administrative requirements, made the successful accomplishment of the project a truly outstanding one. The technical results achieved have been most rewarding and will pay dividends far into the future...I extend appreciation for your excellent performance in an assignment of greatest import to our Navy and our country."

2ND NRDL GOLD/SILVER AWARDS TO HUNT, ROWELL

Edward L. Hunt, a psychologist in the Physiology-Psychology Branch of the Bio-Med Division, received the Laboratory's second Gold Medal for Scientific Achievement; and Monte H. Rowell, a chemist in Chem Tech's Physical Chemistry Branch, received the Silver Medal. The presentations were made in the Auditorium on 6 May 1963 by the Scientific Director, Dr. E. P. Cooper.

By a series of ingenious experiments, Mr. Hunt has demonstrated that small doses of ionizing radiation stimulate the mammalian nervous system directly...the state of neural excitability at the onset of

GOLD AWARDEE -- Edward L. Hunt, recipient of the Laboratory's second Gold Medal for Scientific Achievement, is congratulated by Dr. E. P. Cooper, Scientific Director.

ANOTHER HANDCLASP -- The Silver Medal winner, Monte H. Rowell, is also congratulated by Dr. Cooper.

SUPERIOR CIVILIAN -- Richard R. Soule is presented a Superior Civilian Service Award by Dr. Cooper.

radiation exposure may play an important role in determining the types of reactions which develop during the residual portion of exposure and the immediate post-irradiation period. These findings offer a means through which low dose rate radiation effects upon neural integration can be investigated further in the fields of radiobiology and neurophysiology, as well as psychology.

Mr. Rowell made a valuable contribution of outstanding significance to the advancement of knowledge by the discovery and characterization of ion exchange in molten oxides. The development of liquid and solid organic ion exchangers quite some time ago provided a powerful tool for the performance of difficult separations and for the investigation of chemical species present in aqueous systems. Mr.Rowell's method is the first extension of these concepts to molten inorganic oxides, which permits successful study and chemical manipulation of high temperature systems, such as fused salts. He has applied for a patent on this method of separation.

RESEARCH HERE ON NIH FELLOWSHIP

Dr. Roy H. Jones (on Sabbatical Leave from the Oklahoma State University where he is Head of the Zoology Department) chose to come to NRDL in September 1963 for five months to work in the Experimental Pathology Branch. He is here on a National Institutes of Health Fellowship, the first granted for research at this Laboratory, and is being sponsored by Mr. Leonard Cole, Head of the Experimental Pathology Branch. Dr. Jones is working with Dr. R. K. Main in acquiring radioactive tracer techniques, especially as applied to DNA synthesis and RNA synthesis and cell division. An embryologist, Dr. Jones will use these techniques for study and development in courses he teaches, particularly genetics.

LABORATORY SPONSORS TWO FELLOWSHIPS IN EUROPE

Under Laboratory sponsorship, Peter O. Strom, Jr., Nuclear Chemistry Branch, went to the University of Oslo, Norway, in June 1963 for one year; and Dr. Marvin L. Tyan, Medical Research Officer in the Experimental Pathology Branch, left in September for one year at the world-renowned Karolinska Institute in Stockholm, Sweden.

Working under Professor Alexis Pappas, one of the world's leading nuclear chemists, Mr. Strom will complete his Ph. D. degree work started at the University of California. To further work that he is doing at NRDL, Mr. Strom will seek more complete information on fission product of chemistry, in particular the chemistry of the radionuclide in the neighborhood of the closed shell. According to his supervisors at NRDL, Mr. Strom has consistently demonstrated a high degree of scientific competence and

productivity, and his imaginative thinking in both experimental and theoretical lines has contributed invaluably to the progress of the Branch's program.

Dr. Tyan (working with Professor George Klein, Head of the Tumor Biology Laboratory, and his associates Drs. Erna and Goran Moller) is continuing research he started at NRDL on the development of homo- and hetero-transplantation isoantigens and immunological reactivity in the embryo. In May 1961 Dr. Tyan gave up a successful medical practice in internal medicine and hematology in San Mateo, Calif., and came to NRDL in order to devote his entire time to research. According to his supervisors, Dr. Tyan has demonstrated a most unusual capacity for original thought and investigation in a most difficult and undeveloped field.

GENERAL AWARDS

Thirty four Superior Accomplishment Cash Awards totaling $5,567. were presented to 44 civilians (4 of the total were group awards). Sixteen received Outstanding Performance ratings for the year; and 27 were granted a Quality Step Increase.

One hundred and two Beneficial Suggestions were received - 26 of them were adopted with a total cash award of $540. (25 were intangible and one was for tangible benefits). Six Patent Awards totaled $350.

The Laboratory received the Secretary of the Navy Award for Achievement in Safety and four Safe Driving pins were earned.

Fifteen 20-year service pins were presented. One military man received a Good Conduct medal.

Five civilians completed their career at NRDL and each was presented an attractive retirement pin.

OTHER HONORS

Dr. Myron Silverman, Head, Microbiology and Immunology Branch, was appointed a full member of the Commission on Radiation and Infection, newly organized to assist in the performance of the functions of the Department of Defense Armed Forces Epidemiological Board. The Commission's Director is former NRDLer Dr. Victor Bond, Head, Medical Department, Brookhaven National Laboratory. Among the other members is Dr. S. S. Elberg, Dean of the Graduate School at U.C., a former consultant to NRDL's Bio-Med Division.

Dr. Ralph W. Brauer, Head, Pharmacology Branch, received a distinguished achievement award for his outstanding service to the San Mateo

County Heart Association. He is chairman of the Association's research committee.

For the fourth year, Dr. K. A. Lincoln, Nucleonic's Radiological Effects Branch, is a member of the 12th C. S. Region Federal Career Day Staff. Dr. Dan Love, Nuclear Chemistry Branch, Chem Tech Div., is also a member this year.

Dr. Richard Cole, Head of MED's Countermeasures Evaluation Branch, replaced Dr. L. H. Gevantman, Head, Chem Tech Div., on the Pasadena Board of Civil Service Examiners when his three-year term expired 1 January 1963. Dr. D. J. Kimeldorf, Head, Physiology-Psychology Branch, is the other scientific member from NRDL serving a three-year term. Mr. Bruce Moyer, Civilian Personnel Officer, is a continuing member.

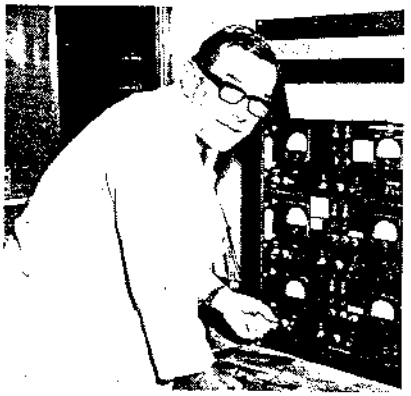
The Commander, Training Command, Pacific Fleet, RADM J. Davidson, wrote to this Command: "The presentations, 'Ship Stand-Off Ranges from Underwater Nuclear Bursts' and 'Shipboard Nuclear Warfare Readiness' given by Mr. R. A. Sulit and Mr. E. J. Leahy, respectively, at the 1963 Nuclear Weapon Symposium at the Nuclear Weapons Training Center, Pacific, were most effective and contributed immeasurably to the objectives and success of this Symposium..."

Dr. J. D. Teresi, Head, Hazard Evaluation Branch, and Dr. C. L. Newcombe of the same Branch, represented NRDL at the Department of Radiation Biology, University of Washington, on a Special Committee, assembled by the AEC's CAPT Jerry Connor, Analysis and Evaluation Branch, Office of Nuclear Safety, Division of Reactor Development.

Dr. Newcombe also served as a consultant to the U. S. Public Health Service in the formulation of plans for launching a research program in radiobiology at the Service's Arctic Health Research Center in Anchorage. Interest was aroused in conducting a radiobiological program throughout the State, due to the comparatively high radioactive fallout in some parts of Alaska. (For the school year 1963-64, Dr. Newcombe has taken leave of absence from NRDL. He is Professor of Radiation Biology at San Francisco State, School of Biology. He is helping to develop a new graduate program in Radiation Biology.)

Dr. James Ferguson, Head, Nuclear Radiation Physics Branch, represented NRDL at the semi-annual meeting of the technical advisors to the DASA Project Officer concerned with Initial Nuclear Radiation Measurements.

Norman Guinasso, Co-op student assigned to the Radiation Effects Branch, was one of 102 chosen to participate in the California State College Overseas Program being conducted for the first time, starting Fall 1963. He is a senior at the University of Heidelberg, majoring in physics.



SCIENTIST-IN-RESIDENCE - The NRDL Scientist-in-Residence Program (approved by the Civil Service Commission in July 1960) brings to the Laboratory scientists who have achieved distinction in their professional disciplines. It provides them with an opportunity for full-time research in an area of interest both to the scientist and to the Laboratory, resulting in the benefit of infusion of new ideas and approaches relative to NRDL's mission.

This year three more Scientists-in-Residence arrived at NRDL for a one year tenure, bringing the total number up to seven since the first person was appointed under this Program in 1961. They are: (Top left) Dr. Wolfe Mostow, an Operations Research Analyst from the Institute of Naval Studies, Cambridge, Mass., who is conducting a program of systems formulation of the AEC Problem "Analysis and Evaluation of the Biological and Environmental Consequences of Nuclear War," and in addition acts as a consultant in areas of weapons effects analyses and naval warfare studies. (Top right) Dr. Walter M. Weyzen an M.D. from the Medical Biological Laboratory, Defense Research Organization, Ryswyk, Netherlands, who is investigating all types of serum proteins in inbred strains of mice by means of different immuno-electrophoresis techniques. (At MBL he was concerned with the therapy of radiation disease by transplantation of bone marrow, more specifically, production of gamma-globulins in radiation chimeras.) And (bottom) Dr. John Playfair of the Clinical Research Department, Royal Marsden Hospital, London, England, who is studying the effect of thymectomy in large animals and effects of bone marrow transplantation in irradiated large animals. He is hopeful that some of the knowledge gained can be applied to humans when he returns to his London position, where his work was about 50/50 clinical and research, with particular interest in fetal liver transplantation and freezing of cells.

CHAPTER V

SEMINARS -- SYMPOSIA -- CONFERENCES

MEETINGS AT NRDL

A Management Development Program was started by CAPT D. C. Campbell, C. O. and Director, in September 1963, directed to management improvement and keeping Laboratory technical supervision abreast of National science administration. The first session leader was Dr. Howard White, Jr., Special Assistant for Research and Development to the Assistant Secretary of the Navy (R and D). He discussed research laboratory management considerations in the Navy reorganization. In October CAPT Campbell led a discussion on the reorganizational recommendations in the "Review of the Management of the Department of the Navy," NAVEXOS P-2426B dated 15 September 1962. Also, there was a brief discussion of the internal Soviet threat. In November Dr. E. P. Cooper, Scientific Director, reported on the Federal Council for Science and Technology Symposium; and Dr. E. R. Tompkins, Associate Scientific Director, told about the Brookings Institution Conference for Federal Science Executives. The annual Spring lecture of the Sigma Xi Club of NRDL was presented on 26 April by Dr. David M. Gates, consultant to the Director of the Boulder Laboratories, National Bureau of Standards. This lecture on "The Energy Environment in Which We Live" wound up a seven-week speaking tour for Dr. Gates, who was selected as a national lecturer for the honorary scientific society of America, Sigma Xi, to cover five western states, including Hawaii.

The Scientific Director presented a Colloquium jointly with the NRDL Sigma Xi Club on 4 October. The speaker was Dr. B. A. Bolt, Director, Seismology Stations, University of California, and his subject was entitled "Natural Vibrations of the Earth."

A special Scientific Director's seminar on 17 December was presented by Dr. A. Johnson, Assistant Research Botanist, UCLA. His subject was "Ecological and Evolutionary Implications of Habitat Disturbance in Northwestern Alaska."

At the Divisional level, frequent seminars were held to present the findings of highly specialized investigations. Speakers were NRDLers and scientists from industry and universities. Those from other countries included: Professor Gabriel Stein, Head of the Physical Chemistry Department of the Hebrew University of Jerusalem; Dr. D. K. Bewley, Hammersmith Hospital, London, England; and Dr. Klaus Becker, Jülich (Germany) Nuclear Research Establishment.

The National Academy of Sciences Subcommittee on Radiochemistry met here 1 March. Dr. N. E. Ballou, Head, Nuclear Chemistry Branch, is Chairman of this group of 12 members. All of the AEC Laboratories and several universities are represented.

About 25 civil defense specialists from Naval Shipyards and Construction Battalion Centers throughout the country attended a four-day Target Vulnerability Studies Conference in July. It was conducted by the TVS Problem Leader, June Brevdy of the Countermeasures Evaluation Branch.

In September an informal conference was held to discuss Service requirements for the proposed ARNE (Aerial Reconnaissance of Nuclear Explosions) Handbook. It would show the effects of nuclear weapons as seen by aerial observers and as recorded on aerial reconnaissance imagery (conventional camera, infrared image and high-resolution radar). Interest in this handbook has been most favorable, with COMNAVAIRPAC and CINCPACFLT endorsing the requirement to utilize this new dimension in nuclear effects analysis.

The overall development of on-site inspection techniques for use in future activities of the Arms Control Disarmament Agency was discussed with a selected group of high level Laboratory personnel on 17 October by CDR R. S. Neasham, USN (Ret.), of the North American Aviation Corp. at Downey, California.

Dr. Paul C. Tompkins, former Scientific Director, on 5 November gave a seminar to senior personnel of the Scientific Department on a proposal for general radiation standards to be issued by the Federal Radiation Council of which he is the Executive Director. He asked for suggestions on modifications to his proposal and received quite a few from the assembled group.

Other groups meeting here included the Optical Society of Northern California; Inter-Laboratory Committee on Editing and Publishing; a seminar sponsored by the Air Force Technical Applications Center, Washington, D. C.; and an AEC Project Review Team.

MEETINGS ELSEWHERE

As in prior years, in 1963 NRDLers played an active role at innumerable scientific meetings throughout the world. Those outside of this country where this Laboratory was represented include: International Meeting on Sector Focusing Cyclotrons at CERN in Geneva, Switzerland; 19th bi-annual International Congress of Pure and Applied Chemistry, London, England; Conference on Nuclear Detonations and Marine Radioactivity, Norwegian Defense Research Establishment, Oslo, Norway; NATO Conference on Mechanisms of Bile Secretion, Newcastle on Tyne, England; British Physiological Society Conference on Measurement of Oxygen Tension, Oxford, England; and 6th International Congress of Nutrition, University of Edinburgh, Scotland.

CHAPTER VI -- TRAINING

One hundred and thirteen employees attended 61 courses in technical and management subjects in 1963. In addition, the Laboratory's vigorous divisional and inter-divisional seminar program included attendance of virtually all investigators.

Thirteen employees were engaged in long-range training programs on the graduate level. As aforementioned (page 36), Mr. P. O. Strom began a year's Laboratory-supported doctoral program in nuclear chemistry at the University of Oslo, Norway; and Dr. M. L. Tyan a year's post-doctoral program in medical research at the Karolinska Institute, Sweden. Mr. L. D. Miller began a similar doctoral program in physics at Stanford and Mr. T. H. Jones and Mr. F. H. Young are engaged in physics and mathematics in Master's programs at San Francisco State College.

Mr. Joseph K. Gong ended four years of "blood, sweat and tears" in May 1963 when he completed requirements for his Ph. D. in physiology from U. C.

Mr. E. C. Evans, III, received his Ph. D. in biophysics from U.C. in September 1963, culminating a long-range Laboratory-supported program.

Two senior investigators participated in the Army-conducted Personnel Management Conferences for Executives and another in a Leadership Laboratory for R and D Supervisors. The Scientific Director attended a Federal Council for Science and Technology Symposium, and the Associate Scientific Director participated in a Brookings Institution Conference for Federal Science Executives.

At the end of 1963 only three Co-op students remained in the Co-operative Education Program as the program continued to be phased out.

The 1963 Summer Program was the largest to date. Applications were received from 40 states in the U. S. Seventy-five were selected including seven college professors, one high school teacher, 30 graduate students and 35 undergraduates. The group represented 39 educational institutions in all sections of the country.

The University of California-NRDL Extension Program continued with an after-hours course in Advanced Nuclear Physics in the Fall 1963 semester. In addition, a course in Biological and Physical Oceanography was given during the Spring 1963 semester.

TWO RECEIVE PH. D. DEGREES -- (Above) Dr. Evan C. Evans, III (third from right) is congratulated upon receipt of his Ph. D. degree by (from left) Dr. Burton Vaughan, Head, Biophysics Branch, to which Dr. Evans is attached; Dr. E. L. Alpen, Head, Bio-Med Division; CAPT D. C. Campbell, Commanding Officer and Director, who made the presentation; Dr. E. P. Cooper, Scientific Director and Dr. E. R. Tompkins, Associate Scientific Director. Also receiving his Ph.D. during 1963 was Dr. Joseph K. Gong (left).

EXPERTS IN ANIMAL CARE -- Two NRDL animal keepers, Henry Carraway (left) and Albert Stinson, were the first two men in Northern California to finish a National course in animal care. Both men were in the Service during World War II, and came to NRDL from the San Francisco Naval Shipyard -- Carraway in 1953; Stinson in 1957.

LCDR J. C. Bartlett, SC, USN, Head, Logistic Support Division, received the U. C. Business Administration Extension's Certificate in the Business Management Program for Technical Personnel.

H. V. Cashdollar, Head, Central Instruments Branch, Engineering Division, developed and presented a training program to enable members of his Branch to perform more effectively in the ever-broadening of the Laboratory's requirements in the calibration and maintenance of radiation measuring devices. This training program is an extension of the program developed by Mr. Cashdollar about three years ago, primarily for the indoctrination of new personnel and the improvement of on-board personnel in the field of radiation measuring devices which is not usually part of the electronic maintenance personnel background.

In order to broaden the knowledge of enlisted personnel, each man was given an average of 11 hours of instruction monthly in many subjects. Five of the 39 enlisted personnel on board were advanced in rate. There were two re-enlistments during 1963. Of the 33 officers aboard, seven were selected for the next higher rank during the year.

CHAPTER VII -- VISITORS

Through the years NRDL has won a widespread reputation for its scientific achievement in studying the effects of radiation and how to combat them. For a wide variety of reasons, 7,710 visitors were here in 1963.

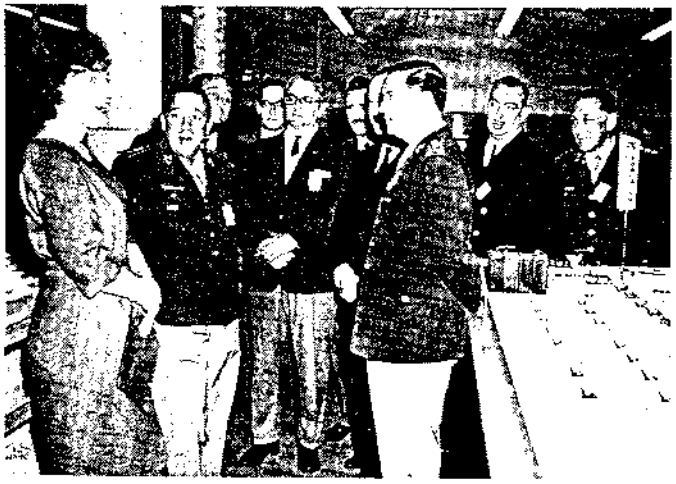
Those from abroad included: Director, ARGENTINA National War College, Contraalmirante (RADM) Rolando O. Esteverena, and about 40 faculty members and students; Commanding officer, PERUVIAN Naval Training Center, CAPT J. Namihas; CNO of CHILEAN Navy, ADM Hernan Cubillos; Dr. R. Stodtmeister, a member of the WEST GERMANY AEC Radiobiological Advisory Committee and Professor of Medicine at Heidelberg; Senior Friendly Allied Naval Officers from ARGENTINA, CANADA, CHILE, CHINA, DOMINICAN-REPUBLIC, ECUADOR, JAPAN, KOREA, PAKISTAN, PHILIPPINES, NETHERLANDS, URUGUAY, and VIET NAM; two FRENCH Army officers from the Surgeon General's Office -- Brig. Gen. Marcel J. Cazeilles and Lt. Col. Andre Aeberhardt; Dr. Gabriel Stein, Head, Physical Chemistry Dept., Hebrew University, JERUSALEM; Maj. Jean Destelle and Maj. Henri Bovagne, FRENCH Army Technicians from Central Armament Laboratory, Military Atomic Study and Research Center; Dr. D. K. Bewley, Hammersmith Hospital, London, ENGLAND; Dr. Klaus Becker, Jülich (GERMANY) Nuclear Research Establishment; Foreign Military, Naval and Air Attaches from 39 countries; Dr. Eugene Zotikov, Chief, Immuno-Hematology Laboratory, Blood Transfusion Institute, Moscow, RUSSIA; Dr. G. Molnar, citizen of HUNGARY, presently at the U. C. Medical Center; Dr. K. Giger, visiting scientist at U. C. this year from SWITZERLAND; Dr. Robert M. Fauve, Pasteur Institute, Sevres, FRANCE; Drs. Helmut Menke, George Benedict, and Herbert Shamfuss, University of Mainz, GERMANY; and Professor and Mrs. Mallet-Guy, Faculty of Medic, Lyon, FRANCE.

A few of the notables from the U. S. who visited this Laboratory were Assistant to Secretary of Defense (Atomic Energy), Gerald W. Johnson; Assistant Secretary of Defense (Civil Defense), S. L. Pittman, accompanied by former NRDLer W. E. Strope and R. E. Holt of DOD; Dr. Howard J. White, Special Assistant for Research to the Assistant Secretary of the Navy (R and D); Dr. Chalmers Sherwin, Deputy Director of Defense for R and E (Research and Information Systems); VADM Paul D. Stroop, USN, COMNAVAIRFORCE PACIFIC; RADM J. W. Williams, USN, Commander, MSTS, Pacific; RADM J. E. Clark, USN, Commander of the Pacific Missile Range; RADM L. D. Coates, USN, Chief of Naval Research; RADM E. J. Fahy, USN, Commander, Mare Island Naval Shipyard; Maj. Gen. H. C. Donnelly, USAF, Commander, Field Command, DASA, Albuquerque, N. M., and his Army Deputy, Brig. Gen. H. L. Ash, accompanied by CAPT W. D. Baker, USN, Officer in Charge, Livermore Division, Field Command, DASA; Col. Frederick J. Frese, Jr. (MC) USAF, Staff DDR and E, and CAPT John A. O'Donoghue, (MC) USN, Bureau of Medicine and Surgery;

National Navy League Chaplain, Monsignor M. F. Connolly; Special Libraries Association's National 1st Vice-president and President-elect, Mildred H. Brode, Head Librarian, David Taylor Model Basin; 25 senior Marine officers and NCO's; Lt. Col. W. E. Mehlinger, GS, USA, Chief, Nuclear Branch, R and D Division, Army Materiel Command, and Mr. J. L. Chamberlain, Scientific Advisor to Commanding General, Army Materiel Command; Commandant, U. S. Army Chemical Corps School, Ft. McClellan, Ala., Col. Laverne Parks; Dr. H. Patt, Argonne National Laboratory; Dr. J. Schooley, U. C. Radiation Laboratory; Commanding Officer, Naval Unit, Ft. Dettrick, Md., CDR L. E. Eisman, MSC, USN; David Tist, Director of the Naval Warfare Research Center, Stanford Research Institute and 13 members of his staff; Dr. Merit P. White, Professor and Head of Civil Engineering Department, University of Massachusetts; Dr. J. Reginald Richardson, Professor of Physics, UCLA; Dr. K. McKenzie, Professor of Physics, UCLA; CAPT G. G. Molumphy, USN (Ret.), BUSHIPS; CAPT E. J. Hoffman, Deputy Chief of Naval Research; Dr. Guy Harris, Navy Underwater Sound Laboratory; Col. Irving J. Russell, USAF, AFWL, Kirtland AFB; A. U. Klement, Div. Bio-Med, AEC; Messrs. James O. Buchanan and A. D. Morrell, OCD; and Dr. Martin P. Reiser, Michigan State University.

FROM CHILE -- The Commander in Chief of the Navy of Chile, Admiral Hernan Cubillos, is welcomed aboard by CDR T. L. Birch.

LECTURER FROM JERUSALEM -- Professor Gabriel Stein (left), Head of the Physical Chemistry Department of the Hebrew University of Jerusalem discusses a problem with Dr. L. H. Gevantman, Head, Chem Tech Division. Under sponsorship of the Chem Tech Division, Dr. Stein was here for a week for exchange of ideas. He presented three lectures: "Some Recent Advances in the Radiation Chemistry of Aqueous Solutions;" "Correlations Between Photochemistry and Radiation Chemistry of Aqueous Solutions;" and "Chemical Basis of the Biological Actions of Radiation."



ARGENTINA GUESTS -- Part of the group of 40 faculty members and students from the Argentina National War College who visited NRDL hear the advantages of the self-service store described by Jean McHugh, secretary to the Technical Services Director. She spoke in Spanish (as did many of the guides) since few of the Argentina visitors spoke English.

CHAPTER VIII -- PUBLICITY

"Big news" events at NRDL during 1963 were the ground breaking ceremony for the new $3 million 70-inch cyclotron, and presentation of the Distinguished Civilian Service Award to Dr. E. L. Alpen. Excellent news coverage was given by the press, radio, TV, and technical journals.

BuShips Journal, in addition to reporting these two highlights, also carried an article in January by E. J. Wesley entitled "Radiation Instrumentation for the Classification of Nuclear Explosions at Sea."

At the request of the Chief of Information, an article on NRDL was prepared for Undersea Technology Magazine.

As in past years, Bay Area papers and hometown papers carried press releases about NRDL personnel.

While perhaps not as intense as in 1962, interest in civil defense continued this year. Several groups visited the NRDL underground shelter at Camp Parks; and several of our scientists lectured on shelter living and decontamination/reclamation.

Two newsreels were produced at this Laboratory during 1963 by a representative of the United States Information Agency for showing in some 46 countries: One on liver physiology experiments, and experiments being done on rats to detect different aging rates in specific tissues of the body; the other - on homograph tolerance in mice. A copy of the latter movie was purchased by the Experimental Pathology Branch. A sound track can be added.

After-hours NRDLers continued to take an active part in civic, school, and church affairs, lecturing often according to their specific talents.

CHAPTER IX -- MISCELLANEOUS

BLDG 815 IS FALLOUT SHELTER

An unusual shipment arrived at NRDL in April -- a shelter radiation kit containing Geiger counters and dosimeters -- the same kit being stocked in fallout shelters throughout the country. Bldg 815 and three Shipyard buildings have been designated as public shelters under the National Fallout Shelter Program. Food, sanitation and medical supplies were to be furnished by Civil Defense authorities.

TRANSPORTATION SURVEY

The Laboratory cooperated fully in the mass transportation survey of all Federal personnel residing in or working in the counties of San Francisco, Alameda and Contra Costa. Purpose of the survey, conducted during July, was to obtain data for emergency situations to assure orderly continuity of government functions by knowing the commute transport needs of personnel.

CAFETERIA WINDOWS

Aside from glass doors at the Laboratory entrance, the only windows are those on the roof top cafeteria. These are in large thermopane sections of approximately 4 ft. by 8 ft. In November 1962 high winds damaged the cafeteria windows and an additional storm in February 1963 made their replacement necessary. Despite an early start through Public Works and contractural channels the replacement did not start until November. Delays in installation were encountered because of rainy weather and the openings produced by removed panes allowed an excessive amount of rain water to enter the building. Installation of new windows with an improved framing was completed in early December 1963.

FOR HEALTH

"Open Season" for Health Plans, 1-15 October, resulted in 72 changes at NRDL, representing 15 per cent of coverage plus 18 new enrollments. This is twice the average anticipated by the Navy Department's Office of Industrial Relations...On 25 October 134 NRDL civilian employees participated in the voluntary chest X-ray program utilizing a mobile X-ray unit parked adjacent to Bldg. 815.

PHILANTHROPY PROJECTS

Eighty-four per cent of the Laboratory personnel participated in the 1963 United Bay Area Crusade, donating a total of $3,674. NRDLers also gave $69.40 to the annual Navy Relief Society Fund Drive.

For the third consecutive year, several women employees at NRDL (providing their own material and working on their own time) made and distributed multi-colored clowns to bring cheer to children. Forty-three were distributed at Eastertime, and 173 at Christmas. They also dressed 12 dolls.

DIVERSE TOPICS

Edna Bowman was the 1963 Chairman of the Council of Librarians, West Coast Navy Laboratories...When Paul McConihe retired here on 31 January, winding up a colorful career that started in 1917 as a young lieutenant in the Army Tank Corps, former President Eisenhower (with whom he served during World War I) sent him a letter of success in retirement..."Chick" Hayashi, Graphic Developments Branch, was "hailed" by the aspiring artists at the Laboratory who have attended his noontime art classes during the past two years. "Chick" has given unstintingly of his own time, talent, and skill in teaching...Again this year Gerald Ferrier, HM1, Medical Department, was selected for the All Navy Pistol Team Matches held in Jacksonville, Fla., from 10-21 June...After 28 years of commissioned Army service (six years active during World War II), L. L. Wiltshire, Technical Developments Branch, was promoted to colonel and retired on 14 July 1963.

GETTING TO KNOW YOU

NRDLers again pursued an active after-hours recreation program including golf, bridge, bowling, fishing, and tennis tournaments...The annual picnic was held at Flood Park on 22 June...However, the annual Christmas party, scheduled for 7 December, was cancelled consistent with Navy directives announcing the 30-day period of National mourning...Three NRDLers climbed the U. S.'s highest mountain (excluding Alaska), Mt. Whitney (14,496 feet). They are Dr. W. Shelberg, Applied Research Branch; George Plummer, Nuclear Radiation Physics Branch; and LCDR J. Bartlett, Head, Logistic Support Division. Bob Anderson, Technical Developments Branch, received his Private Pilot's license on 29 November, and Gaynor Abbott, Radiation Effects Branch, made his first solo flight on 1 December.