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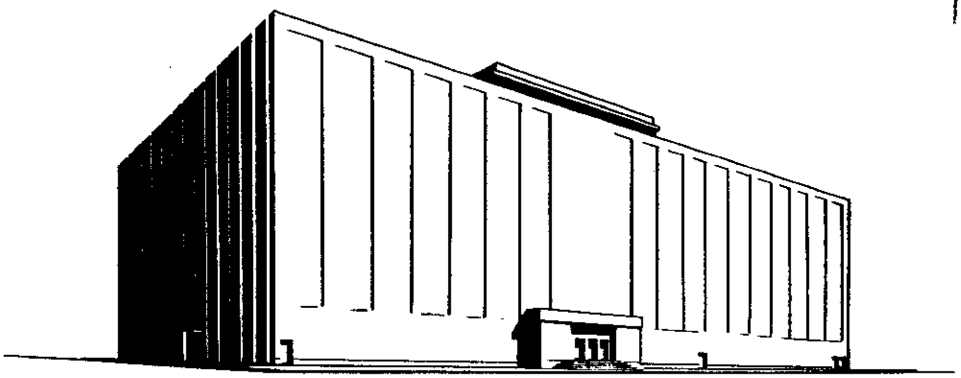

History of **U. S. NAVAL RADIOLOGICAL DEFENSE LABORATORY**

1946 – 1958

S A N   F R A N C I S C O   C A L I F O R N I A

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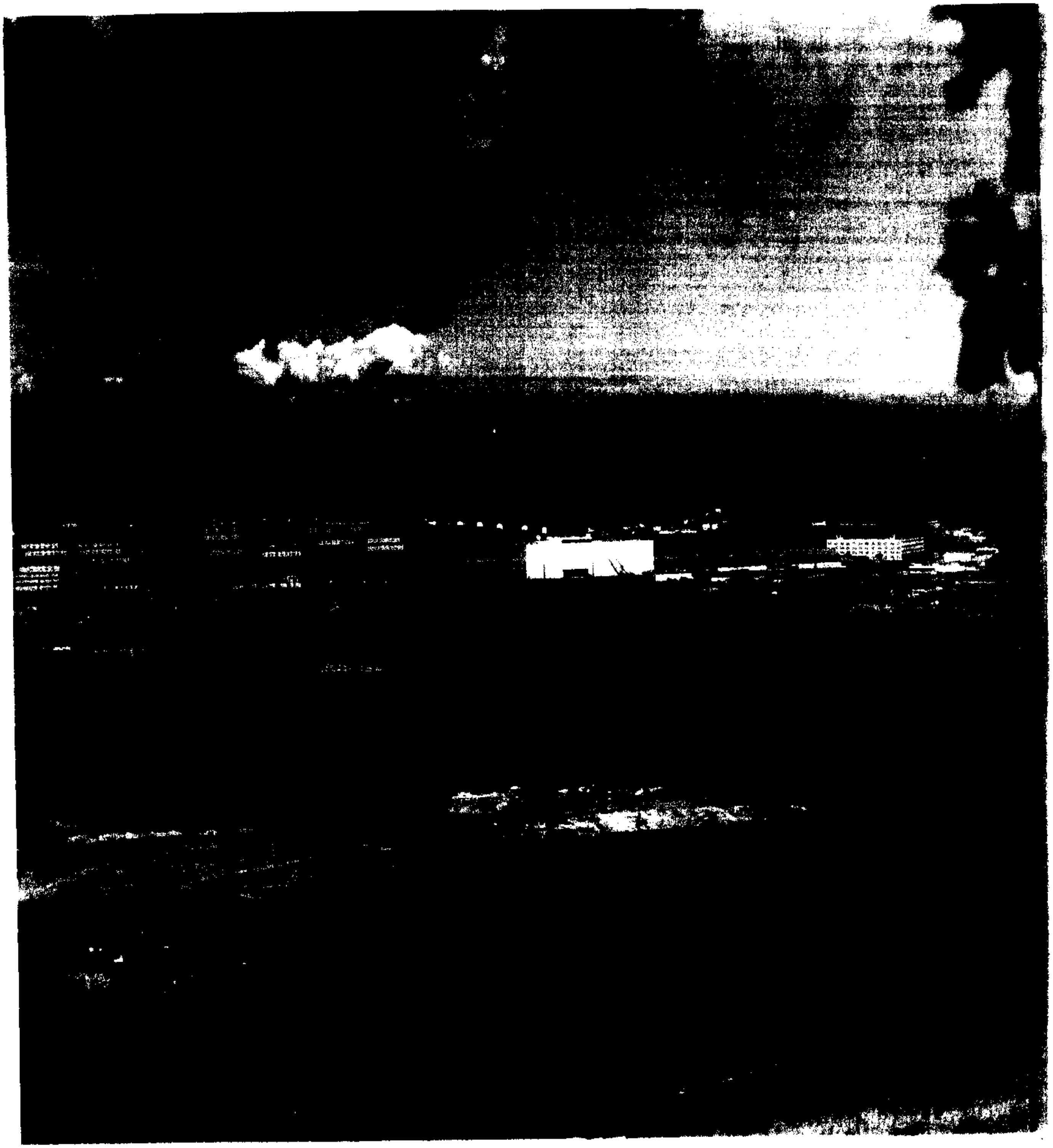
OPNAV REPORT 5750-5

HISTORY

OF

THE UNITED STATES NAVAL RADIOLOGICAL DEFENSE LABORATORY

1946 — 1958



BIRTH OF A LABORATORY

The United States Naval Radiological Defense Laboratory, now housed in a multi-million dollar building in San Francisco, California, has come a long way in twelve years — literally from a handful of pioneers in a "rented room" to a many faceted, versatile staff of 600 in an ultra-modern facility all its own. The need for such a laboratory, although unrecognized at the time, actually dates back to 1942 when a group of scientists in Chicago succeeded in creating the first self-sustaining nuclear chain reaction. Four years later, in July 1946, Operation CROSSROADS, the first nuclear tests held in the Pacific, left no doubt that man was faced with the necessity for coping with strange and unprecedented problems for which no solutions were available. Immediately after CROSSROADS, discussions were held by a group of naval officers in Washington concerning the need for a nuclear laboratory to find those essential answers. The rapidity with which it came into being constitutes everlasting credit to their farsightedness.

In August 1946, the Chief of Naval Operations established a Radiological Safety Program for the Navy that would undoubtedly entail finding a definite location for this work. The main question was whether to use some place already in existence, or set up an entirely new headquarters. By September the target ships used in CROSSROADS had returned to the West Coast, making decontamination of them imperative. Standards were established in October, with about a dozen junior naval officers, who had served as monitors during the tests, carrying out decontamination procedures on a sort of trial and error basis. Headed by a lieutenant commander, this small band formed the Radiological Safety Section (probably the first such group ever organized) as part of the San Francisco Naval Shipyard Industrial Laboratory, with headquarters in two rooms. Their equipment consisted of one coffee pot and six Geiger counters, only two of which worked.

Their problems in decontamination are a story apart, that can best be summed up in the remarks of one of them in retrospect: "We would decide among ourselves how to go about the new type of job, then do it, and then dispatch BuShips and BuMed asking if it were all right to do it that way. If we were right we would dispatch our counterparts in other Shipyards, reassuring them. Anyway, many of the techniques we developed for monitoring and decontaminating ships are still used today."

A letter from the Chief of the Bureau of Ships, dated 18 November 1946, directed the Commander, San Francisco Naval Shipyard to increase already existing laboratory facilities for radiological studies to:

(1) Develop instruments for detection of radioactivity;

(2) Develop equipment for protection of personnel on shipboard;

(3) Develop methods and equipment for decontamination of ships.

The sum of $75,000 was allotted by the Bureau of Ships, for installation, maintenance and operation of equipment. Assignment of an officer to guide the new work was promised. The last sentence of that letter is worth noting — "...It is expected now that these facilities will be utilized for a continuing research and development program." Thus, a new laboratory was born of stark necessity, but even then its prospects for a bright and useful future were foreseen.

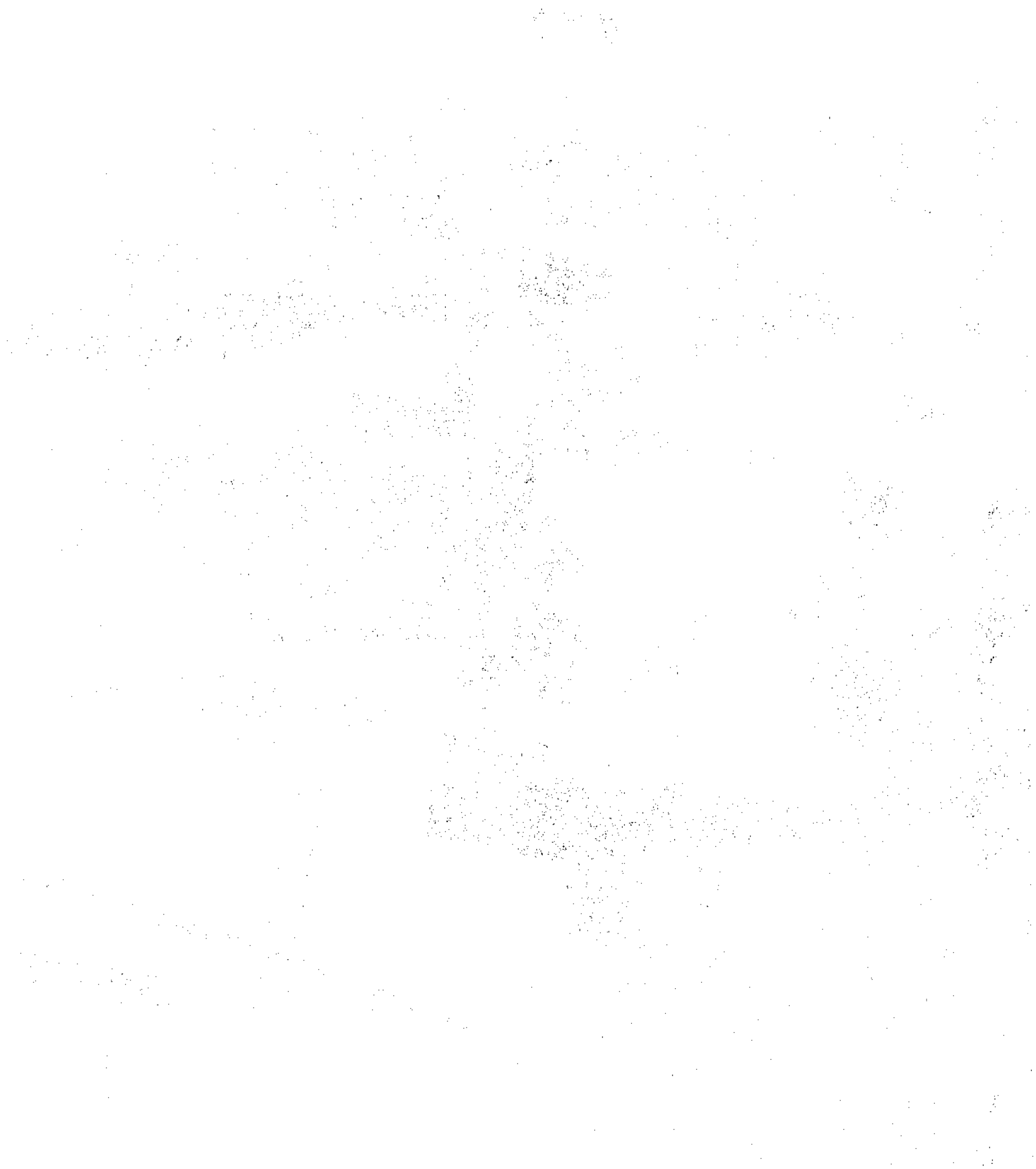
Choice of a Site

San Francisco was considered the logical place for the Laboratory for a number of sound reasons, not the least of which was that it is ideal for living. The scarcity of experienced scientific personnel made this a deciding factor. The proximity of two major universities, and the fact that San Francisco was the natural staging point for future Pacific Weapons tests were two more points in its favor. A Shipyard was advantageous for logistic support, and San Francisco Naval Shipyard had already been selected for berthing the CROSSROADS vessels upon which the decontamination methods would be tried.

In Search of a Name

Not until 26 February 1947 did the new Laboratory acquire a name of its own, having previously been referred to as a "laboratory for radiological studies." On that date by Shipyard Order, "The Radiation Laboratory of the San Francisco Naval Shipyard" was established, physically independent of the Shipyard Industrial Laboratory. The order also specified that the Bureau of Medicine and Surgery would utilize these facilities and provide its own officer personnel, equipment and supplies.

Confusion, bound to arise from the similarity in the names of this Navy Laboratory and the University of California Radiation Laboratory, led to a recommendation made to the Bureau of Ships by the Shipyard Commander on 4 February 1948 that the Navy change its Laboratory's name to the "Atomic Defense Laboratory." This suggestion was duly considered by Washington officials and voted down because atomic defense



San Francisco — Glamor City of the West

came under the jurisdiction of the Secretary of Defense, with other Government agencies, such as the Atomic Energy Commission and Public Health Service actively engaged in this field. To use the name "Atomic Defense Laboratory" might imply that this Laboratory was in charge of the atomic energy problems for the entire nation.

Other names discussed were "Naval Radiological Laboratory" and "Naval Radiological Defense Laboratory." Realizing the American propensity for shortening names to initials, those in authority felt that "NRL" could bring further confusion with the Naval Research Laboratory. Consequently, the name "Naval Radiological Defense Laboratory" was selected.

At about the time the final decision was made, two other names were suggested, "Military Radiation Laboratory," and "Radiation Defense Laboratory." Too late ! The official designation had been issued on 21 April 1948 and NAVAL RADIOLOGICAL DEFENSE LABORATORY it was, generally known ever since as NRDL (pronounced "Nurdle"). In September 1950, because it had reached a stage wherein its mission was widely divergent from the Shipyard, the Laboratory was made a separate activity, although still under the command of the Shipyard Commander, and the prefix "United States" was added. Implementation of the directive took place on 1 October 1950.

EVOLUTION OF A MISSION

The first defined mission of the Laboratory was incorporated in its initial report written early in 1947. It stated that "The immediate aim is to provide adequate scientific facilities to fully exploit the opportunities for technical investigations offered by the vessels participating in Operation CROSSROADS."

The broader mission was to "serve as a nucleus for the research and development of the radiological problems of atomic warfare; to furnish a highly skilled organization specifically trained in the naval phases of these problems; and to supply and collect technical information and data needed in training of military and civilian personnel to meet radiological problems of the future."

A year later in March 1948, the mission was reworded thus: "To conduct investigations and develop information concerning effects and consequences of dispersed fissionable materials, fission products or other radioactive substances." This was interpreted to include:

(1) Estimation and evaluation of hazards.

(2) Investigation of all phases of decontamination.

(3) Means of minimizing contamination and personnel risks.

(4) Establishment of safety procedures.

(5) Establishment of tolerance levels.

(6) Determination of toxicities and metabolism of radioactive substances.

(7) Necessary basic research in connection with the above.

In 1949 a bit more was added "...other radioactive substances present and resulting from nuclear processes on vessels, in harbors and anchorages, and in shore establishments and the corrective measures therefor."

In 1950 the mission was further revised to read: "Conduct basic and applied research and development concerned with the radiological safety program of the Armed Forces; investigate the effects and consequences of dispersed fission products, fissionable materials, and other radioactive substances present and resulting from nuclear processes on ships at sea, in harbors and anchorages, and in shore establishments; and determine and develop corrective measures for the foregoing."

On 1 November 1955, a Notice from the Secretary of the Navy contained the concise mission which, except for substitution of the word, "nuclear" for "atomic," still exists. Thus, the mission now reads:

"Conduct basic and applied research on the physical and biological effects of hazardous nuclear and thermal radiation, including interrelated effects such as shock or blast, and the dispersion and contaminating effects of fission products resulting from a nuclear explosion or from controlled nuclear processes; develop and evaluate Radiac devices and shielding equipment or materials for protection of personnel, reclamation or decontamination procedures for shipboard, aircraft, and land areas; preparation of data for training information required by the military services, including assistance to other federal agencies and government contractors in the fields of nuclear and radiological warfare; and develop the use of radioisotope and other tracer techniques in the above technological fields."

The detailed mission follows:

Conduct basic and applied research in the following categories:

(1) Characteristics of hazardous radiations and radioactive materials; including characteristics of thermal, nuclear and radioactive particulate fallout and radioactive materials or contaminants, including biological effects.

(2) Personnel hazard from nuclear and thermal radiation and radioactive materials, including biological effects.

(3) Appraisal of effectiveness and countermeasures in the field of nuclear warfare.

(4) Development and appraisal of radiac instrumentation including basic supporting research for various kinds of radiation hazard from a nuclear detonation.

(5) Development and evaluation of personnel protection materials and measures from radiation hazards and contamination in nuclear warfare.

(6) Nature of radioactive contamination of materials, and development of protective and reclamation procedures.

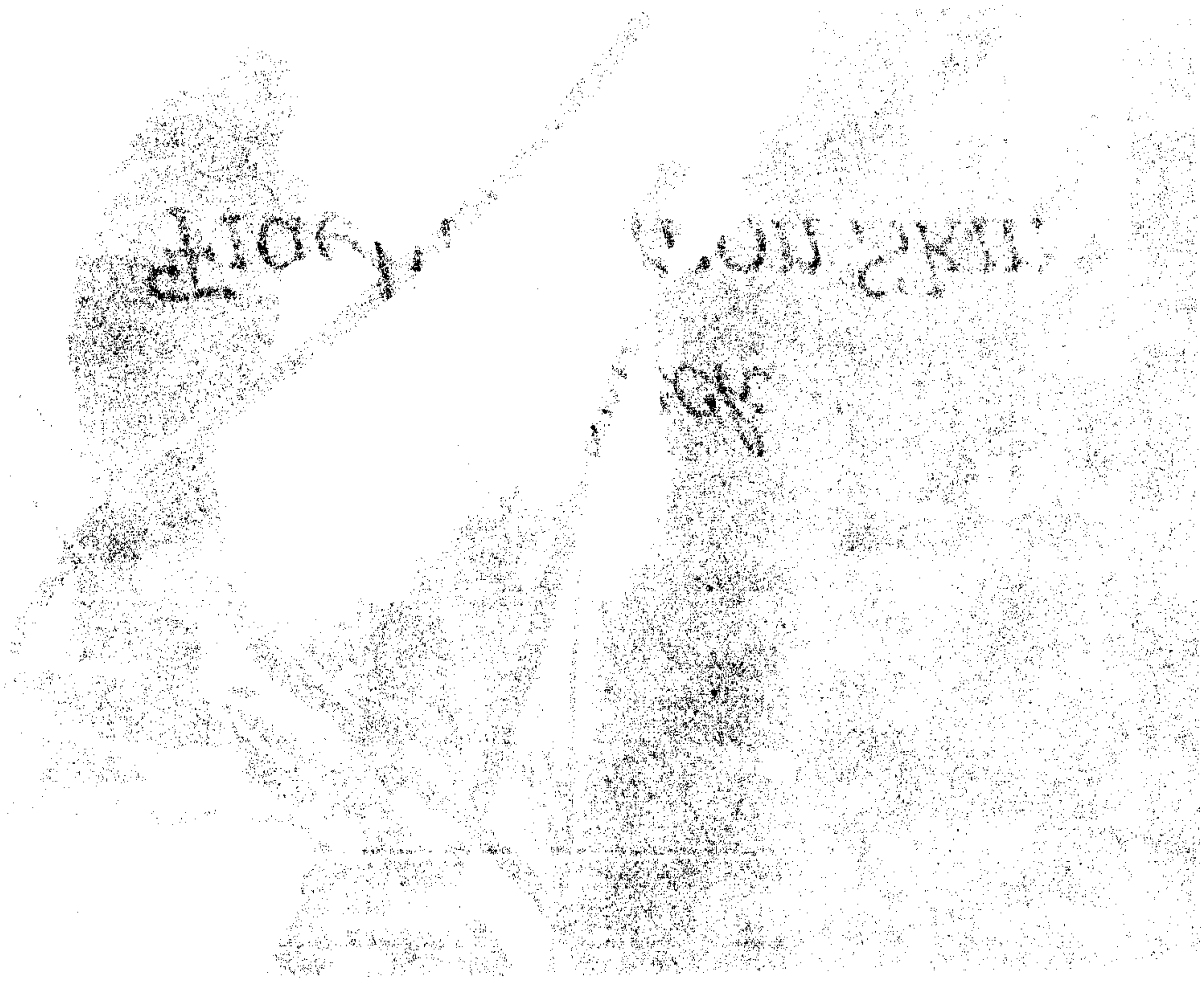
(7) Investigations in all general problems in radiological defense, including participation in nuclear weapons tests in fields related to the above categories.

(8) Act as a primary consultant and adviser in the field of defense against nuclear weapons and protection in nuclear processes to all branches of the Defense Department, and as occasional consultant to the Atomic Energy Commission, U.S. Public Health Service, civil defense organizations and others.

(9) Preparation of training manuals and other instructional material in the field of radiological defense for the Defense Department.

Thus, it will be seen that from the narrow field of decontamination studies has evolved a well rounded mission incorporating investigations in biology, radiation instrumentation, radiochemistry and other challenging facets of the problem. As a matter of fact, the mission of this Laboratory is so extremely broad that it transcends the idea of research for military use only, since nuclear radiation does not differentiate between the wearers of uniforms and those of civilian clothing, but embraces all mankind.

Unlike the majority of military laboratories, emphasis at NRDL is laid not upon output of "hardware," but of knowledge — basic scientific knowledge in the form of technical reports and memoranda; military knowledge in the form of tactical doctrine, manuals, procedures; knowledge for Civil Defense in the form of plans, systems and reports. The "hardware" output of the Laboratory — radiac instruments — constitutes only a small portion of the work.



Decontamination by water — NRDL's first task

ORGANIZATION

Early in 1947 a simple organization chart was proposed, set up in terms of people instead of units:

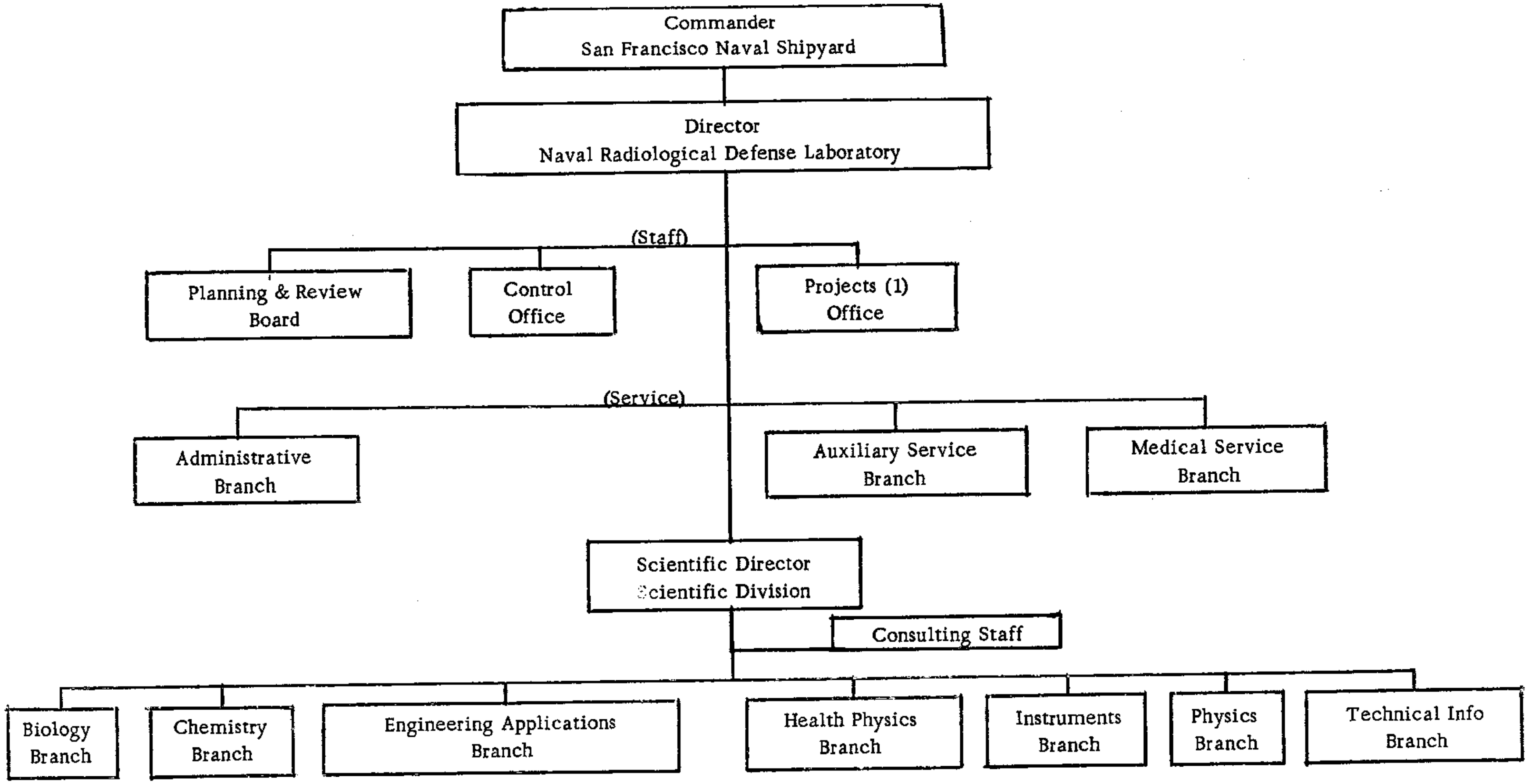
NAVAL PERSONNEL	CIVILIAN PERSONNEL
Officer-in-Charge	Technical Director, P-7
Monitoring Officer	Physical Chemist, P-6
Training Officer	Physicist, P-5
Instrumentation Officer	Chemist or Chemical Engineer, P-5

This was soon expanded to include several research associates, technical assistants, and service groups under an administrative assistant, a library, glass shop, stock room, etc. Within a year, the scientific organization was set up, designating eight divisions: Auxiliary Services, Biology, Chemistry, Engineering Applications, Health Physics, Instruments, Physics and Technical Information and Materials. On 1 October 1948 the designation of Technical Director was changed to Scientific Director, a title still in effect.

The first formal organization chart is dated 1 July 1949 (see page 7) Comprising only a single page, it shows a Commanding Officer, a Director with a Projects Office, Control Office and Planning Review Board serving as his staff; a Scientific Division with seven branches and a Consulting Staff under a Scientific Director; and a Services Division composed of Administrative, Auxiliary and Medical branches. The Auxiliary Services Branch originally assigned to the Scientific Division was shifted to this service group.

Survey Predicts Growth

Of interest is a report by the Office of Industrial Survey in November 1949, recommending that, since it was the only activity known to be engaged in studying the problems associated with radiological contamination, full consideration be given to the obvious future growth of the Radiological Defense Laboratory. It would undoubtedly be called upon to conduct specific investigations by the various Services and later, the results obtained would find ready use by Civil Defense organizations.



Notes:
(1) includes
- Army Corps of Engineers
- Bureau of Aeronautics
- Bureau of Medicine & Surgery
- Bureau of Ships
- Bureau of Yards and Docks
- Army Chemical Corp

Organization
Naval Radiological Defense Laboratory
Date 1 July 1949

Because of this wide scope, the report urged that funds for laboratory overhead should not be drawn from a single agency, but should be included in the allotments made for specific projects by participating agencies.

The report went on to say that the proposed conversion of a Shipyard building would not prove adequate for the expanding Laboratory, and that use of this building would interfere with the industrial mobilization of the Shipyard. "In the opinion of this Office," it stated, "a laboratory of the size and scope that this one will eventually reach has no place within the confines of an industrial activity." Further recommendation was made that the Laboratory be established as a National Laboratory. No action was taken on these proposals.

NRDL Departmentalized

At the beginning of 1951 the Laboratory was divided into departments and organizational codes assigned--Scientific Department with four divisions to conduct research in different areas of radiological defense: Biological and Medical Sciences, Chemical Technology, Nucleonics, and Special Operations Divisions; Administrative Department, composed of service groups to support the scientific research: Technical Information, Engineering Services, Materials and Accounts, and Administrative Services Divisions; Management Engineering Department for control of financial, space, facilities and disaster control; Organization and Methods, Budget and Facilities Engineering Divisions: and Medical Services Department to be responsible for the health programs and for administration of all naval medical personnel to make them available to the research program: Radiological Health and Photodosimetry Division. The Director's Staff was composed of the Project Officers, Industrial Engineering Officer and Personnel Assistant.

Each division was divided into branches and sections with functions defined on the multi-paged chart. Few deviations from that basic organization have since occurred. Major changes include: Special Operations Division abolished; Military Evaluations Group assigned to the Scientific Director's staff and later designated as Military Evaluations Division; reorganization of the Administrative Services Department which was redesignated Technical-Administrative Services Department, and later split into Technical Services Department and Administrative Department; Comptroller organization established to conform to a new Navy Department concept bringing together accounting, budgeting and management engineering functions; Chemical Technology Division reorganized (with greater emphasis on fallout) and a Field Test Group added; Security Branch combined with Communications to form a division; and Nuclear Radiation Shielding Branch, formerly a section in Nuclear Radiation Branch, established.

Other adjustments have taken place and still more will be incorporated in the Laboratory's organization — all aimed toward a progressively better coordinated activity. It is interesting to compare the first elementary chart with the current over-all chart of the Laboratory's organization. (See page 10)

Boards and Committees — Internal

In lieu of a more detailed organization, special boards and committees were formed in February 1948 to carry out various important functions. These included Committees for Radiological Safety, Library, Personnel, Education, Seminars, and Planning and Review. The latter was changed to a Board in August 1948 and incorporated an Executive Committee, later termed the Research Council.

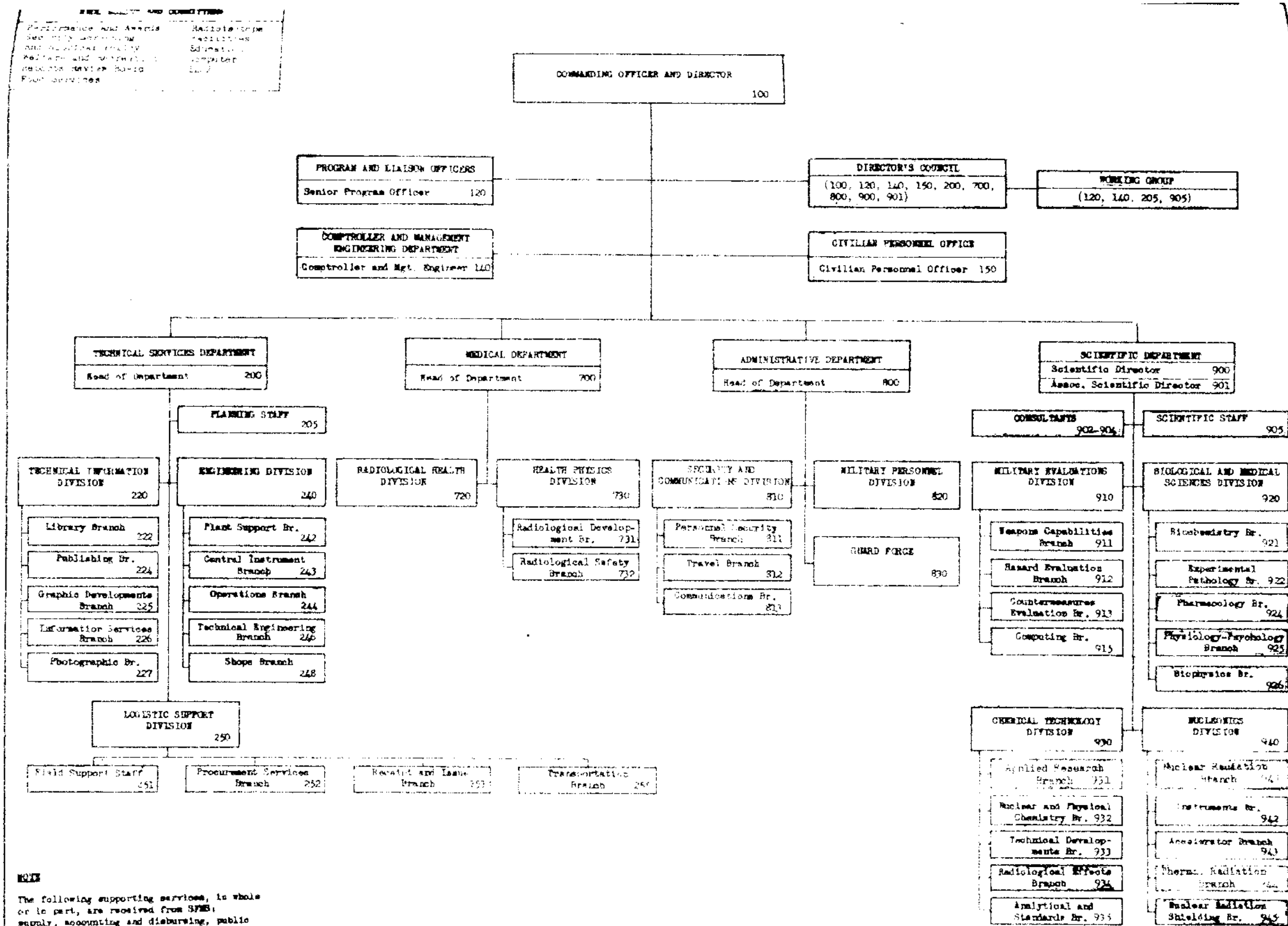
Through the ensuing years, although a more complex organization has been developed, a definite need remained for special groups from different units to pool ideas and disseminate information to all segments of the Laboratory. Following are the boards and committees set up at various times, but still in existence:

Reports Review Board. (7 members) Originally review of reports was mainly the responsibility of the Special Assistant to the Technical Director. In June 1954 the Reports Review Board was established, chairmanned by the Scientific Director or Associate Scientific Director and composed of certain key members of the Laboratory. Since its organization this Board has reviewed a total of 566 reports.

Performance and Incentive Awards Board. (7 members) These functions were originally performed by two separate groups — the Performance Rating Board and the Committee on Awards. The two were amalgamated in 1958. Members are appointed by the Commanding Officer and Director from different departments each year.

Food Services Board. (5 members) The need for this body arose in 1955 when the Laboratory became united in one building. A rotating membership, appointed by the Commanding Officer and Director, formulates and effects plans for the operation of food services within the Laboratory.

Education Committee. (6 members) It has always been the policy of the Laboratory to encourage increased competence of its professional members. From the start a committee on education has served as a planning and advisory group in educational programming. The first such group also arranged weekly seminars, a function relegated to individual units as the Laboratory grew in numbers. Members of the Education Committee are appointed by the Commanding Officer and Director to serve one year.



NOTE

The following supporting services, in whole or in part, are received from SFNS: supply, accounting and disbursing, public works, boundary security, and communications.

June 1958	APPROVED: CAPT, USN, COMMANDING OFFICER & DIRECTOR	U. S. NAVAL RADIOLOGICAL DEFENSE LABORATORY	BUREAU OF SHIPS	BASIC STRUCTURAL ORGANIZATION	CHART NO.

Radiological Policy Committee. (7 members) This is an outgrowth of the Radiological Safety Committee established in the first months of the Laboratory's existence. Members are appointed for an indefinite term by the Commanding Officer and Director from nominations by division or department heads. All policies and procedures are formulated by this committee which also serves as a reviewing board for cases of radiological exposure in excess of the maximum permissible limit.

Radioisotope Committee. (5 members) This group, set up as required by the Atomic Energy Commission, determines that proposed use of isotopes is required and that adequate facilities exist to handle the material. Membership is composed of heads of scientific divisions

Employees' Council. Established in 1957, this group primarily constitutes an avenue of communication between management and employees.

Welfare and Recreation Committee. (9 members) This committee occupies a semi-official position in the Laboratory. It is described later in this history under the heading of Informal Organizations.

Computer Scheduling Committee. This committee, composed of six members, was established in February 1958 to resolve questions of priority for programming in connection with the Laboratory computer.

Boards and Committees — External

In addition to its own internal committees, the Laboratory participates in the operation of other important groups.

Civil Service Board of Examiners for Scientists and Engineers in Pasadena, California. NRDL provides two senior scientists and the Civilian Personnel Officer as members of this Board.

Rating Panel for the Pasadena Board. Members of this panel assist the Civil Service Commission in rating certain types of scientific engineering and subprofessional applications to determine qualifications for placement in Navy laboratories. NRDL has 12 members on it.

San Francisco Naval Shipyard Board of Examiners. This Board is primarily concerned with ungraded employees. One member from Civilian Personnel Office represents the Laboratory.

Inter-Laboratory Committee on Facilities. NRDL joined this committee of West Coast Naval Laboratories in March 1952. Purpose of the Committee is to promote cooperation between the members in use of special or unique facilities and services and available talents. As a result of the Committee's work the Laboratory has made profitable use of the facilities of other members and has been able in turn to help them.

COMMANDING OFFICERS

From the beginning, the Laboratory has been under the direction of a naval officer. Fortunately, its leaders have been men singularly well equipped to head a research organization, several of them having had extensive experience in various aspects of atomic energy work. First "Officer-in-Charge," the title within a few months was changed to "Director." When set up as an activity separate from the Shipyard the Director was accountable to a Commanding Officer who was also the Commander of the Shipyard. It was not until 16 September 1955 that, "in the interests of good management and in recognition of the separate identities of the two activities" the billet designated as Director was changed to Commanding Officer and Director. The Laboratory thus became a completely independent command.

The chronological record of NRDL commanders follows:

OFFICER - IN - CHARGE

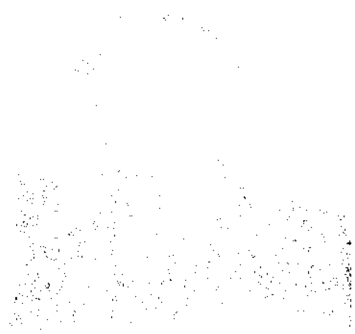
LT Roger G. Preston	2 February 1947	-	2 May 1947

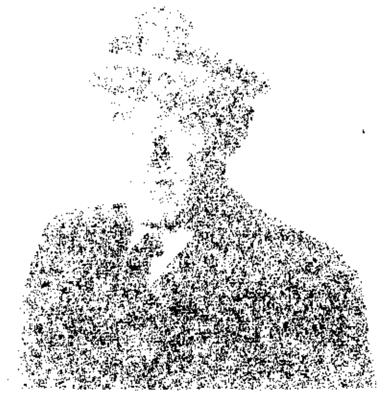
DIRECTOR

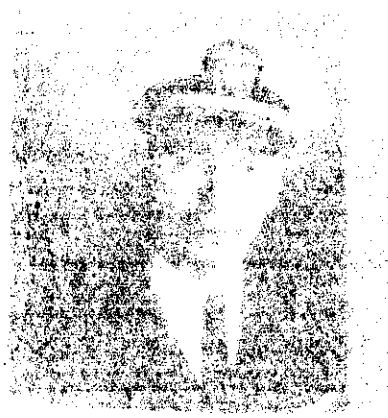
CDR John J. Fee	2 May 1947	-	18 July 1950
CAPT Joseph L. Bird	18 July 1950	-	17 July 1953
CAPT Robert A. Hinners	17 July 1953	-	16 Sept. 1955

COMMANDING OFFICER AND DIRECTOR

CAPT Robert A. Hinners	16 Sept. 1955	-	15 August 1956
CAPT Richard S. Mandelkorn	15 August 1956	-	30 July 1957
CAPT Floyd B. Schultz	30 July 1957	-	28 October 1957
CAPT John H. McQuilkin	28 October 1957	-	







NRDL COMMANDING OFFICERS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CHRONOLOGICAL RECORD OF NRDL COMMANDERS

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Brief Biography of Current Commanding Officer and Director

Captain John Howard McQuilkin, was born in Washington, Indiana but grew up in Baltimore, Maryland. Before entering the Naval Academy he attended Polytechnic Institute and the Severn School. After graduation near the top of the Class of 1935, U. S, Naval Academy, and two years at sea aboard the USS SARATOGA, he began postgraduate study of naval construction at the Massachusetts Institute of Technology. The three-year course culminated in a Master's Degree. This was followed by three years at Mare Island Naval Shipyard, where he worked in Design, Ship Superintendent and Planning Departments. Late in 1943 he was ordered to the Staff of Commander Destroyers, Pacific Fleet as Material Officer. From 1946 to 1950 he was assigned to the Bureau of Ships Hull Design Division, with an additional year as Assistant Director of Standardization in the Office of the Chief of Naval Operations.

Captain McQuilkin had his first contact with atomic energy at the Bureau of Ships, prior to 1950 when engaged in the design of nuclear weapons installations on naval ships. As Deputy Chief of Development (1951 - 1954) Armed Forces Special Weapons Project Field Command, Sandia Base, New Mexico, he was in close contact with nuclear weapons tests which afforded good background for his present assignment.

In April 1955, after a return to Mare Island for a year as Repair and Shipbuilding Superintendent, he was again assigned to Ships Design Division of the Bureau of Ships where he stressed the need for development of design standards to include protection against the effects of nuclear weapons on Navy Ships. His ten years' work in ship design included nuclear propulsion, especially during the years just prior to his assuming command of the Laboratory, when he was intimately concerned with the design of nuclear propelled submarines and aircraft carriers.

Captain McQuilkin received the Bronze Star Medal for World War II service. Since taking command of NRDL he has received a Letter of Commendation with Ribbon and Metal Pendant from the Secretary of the Navy, for achievements in ship design at the Bureau of Ships. His campaign medals include American Defense, American Theatre, Pacific Theatre, Philippine Liberation, World War II Victory, National Defense Service. He is a member of Sigma Xi, the Society of Naval Architects and Marine Engineers and the American Society of Naval Engineers. He is married and has two children.

SPONSORSHIP

NRDL has never lacked enthusiastic backers. Even before it was established, the Office of Naval Research evinced a definite interest, informally offering assistance in obtaining personnel and in liaison with other agencies, and financial responsibility for "a separate organization supported by the Office of Naval Research." Other Navy bureaus also were enthusiastic, and emphasized that all Navy activities with a stake in the operation should cooperate to make it a success.

As part of the Radiological Safety Program created by the Chief of Naval Operations in August 1946, the Bureau of Ships had been given certain responsibilities for developing the means and techniques for carrying out that program. The logical outcome of the undertaking was that BuShips should become the Laboratory's parent organization. Because of the inherent biological hazards, the Bureau of Medicine and Surgery also had an obligation to fulfill in studying those hazards associated with decontamination. Beginning early in 1947 other Navy Bureaus which had already been assigned work in certain development aspects of the RadSafe program offered cooperation and financial support to the new Laboratory. By mid-year the Bureau of Yards and Docks and the Bureau of Aeronautics joined in the sponsorship, and as soon as the program was well under way, ordered officers to represent them at the Laboratory.

In August 1947 a joint BuShips-BuMed letter to the Atomic Energy Commission requested that certain information in fields relating to radiation be made available to the Laboratory from the AEC's storehouse of valuable knowledge gleaned from the Manhattan District, in order to avoid needless duplication of effort and to insure prosecution of the vitally important research by correct procedures. About the same time the War Department's Corps of Engineers became interested in the Laboratory and proffered support. An Army engineering officer was assigned as Project Officer, and, because he was the Senior Project Officer, served as the Deputy Director of the Laboratory for several years.

A few months later the Armed Forces Special Weapons Project, the Army Chemical Corps and the Air Force supported certain phases of the Laboratory program, and eventually set up billets for their own project officers to make available to the Laboratory "such information and assistance as may be useful in the solution of its specific problems," in certain enumerated categories and with certain stipulations as to procedures and clearances. Later additions to the sponsor list were the U.S. Public Health Service (1950) and the Federal Civil Defense Authority (1951). For a brief time in 1951 - 52 the Nuclear Energy for Propulsion of Aircraft Project (NEPA) sought to learn the physiological effects of short term exposures to high levels of nuclear radiation, such as that of a power pile.

Almost a Tri-Service Laboratory

A memorandum in December 1951 from the Assistant Secretary of Defense to the Research and Development Board (RDB) suggested that, owing to interservice interest in NRDL and the necessity for joint funding of programs, the Laboratory might well be treated as a joint agency of the Department of Defense. The memorandum also suggested that a proposed Air Force Laboratory at Bedford Massachusetts might be combined with NRDL for such a joint agency. In reply, the RDB expressed strong approval of NRDL "under present conditions of sponsorship and

Meeting with a Sponsor — Army Technical Services

operations," and stated that the program planned for the Air Force Laboratory would not materially affect the need for the NRDL facility. "The program demands on NRDL," it said, "have been increasing since its inception. The ever-increasing extent and variety of atomic energy applications in military operations leave little doubt as to the future need for such a facility."

The Air Force Laboratory did not get approval of the RDB, and consequently expressed interest in greater participation in NRDL's biomedical program. The next discussions of NRDL's future concerned its becoming a medical laboratory concentrating on biological and chemical warfare fields. In 1953 there was more discussion on the tri-service status, providing that funding and staffing agreements could be reached. The Air Force showed little interest, but in 1954 the Army entered into certain terms of agreement for a joint Army-Navy program, with the Laboratory remaining under Navy management. In general these terms still govern Army participation in the Laboratory program.

In 1956 the Project Officers of military sponsors were redesignated Program Officers, and the current staff has officers representing all of the Armed Forces.

PERSONNEL

Initially the staff was composed of a few naval officers and enlisted men who had formed the Radiological Safety Section of the San Francisco Naval Shipyard. Currently the military complement, exclusive of the Program Officers, includes physicians, members of the Medical Service Corps, Hospital Corps and Supply Corps, WAVES, engineers, aviators, civil engineers, and regular line officers.

From the very beginning, however, it was recognized that the Laboratory would eventually be predominantly civilian in nature, and four days after the initial Laboratory for Radiological Studies was established, details of personnel requirements were spelled out, even to the types of degrees demanded and the specific duties to be assigned key civilians, particularly the Technical Director. Pending establishment of Civil Service positions, it was suggested that technical personnel be engaged on personal service contracts to avoid delay.

One of the most vexatious problems that beset the new Laboratory was the acquisition of qualified technical personnel. Finding competent civilian scientists presented a real dilemma. The first "Progress report" (early in 1947) stated that "to staff the Laboratory with inefficient and untrained civilian personnel simply to fill the required ratings would be a serious mistake which would immeasurably handicap the growth, progress and prestige of the Laboratory." Therefore, it was recommended that all key civilians be employed on a trial basis and that special care be observed in selection of the Technical Director, perhaps using the consultant basis of employment.

In addition to the original eight key members, six laboratory technicians with undergraduate degrees at the P-2 level and two assistants for routine laboratory work were included. (At that time, the Civil service "Professional" (P-1, etc.) designation was in use, later supplanted by the General Schedule (GS-, etc.) system.

Actual hiring of civilians began in March 1947. Within a year, the Laboratory roster showed a total of 142, subdivided into: 15 officers, 20 enlisted men, 56 professional civilians, 18 sub-professionals, 33 administrative, clerical and fiscal. Included in the officer list were project officers from participating agencies. At that time (1948), it was estimated that the maximum ever to be reached would be 100 professional, 100 non-professional and 40 military with allowance for 50 percent increase if required in emergency.

Unpredicted Growth

In less than a year, the number had climbed to 188 and in a few months (July 1949), the 200 mark was reached, with 125 employed directly on projects and 75 in supervisory, administrative and support capacity. By March 1950, total strength was 250, about 100 short of the number necessary for full prosecution of the assigned program. The Korean conflict had a rapid effect on hiring at the Laboratory. In about six months, the roster was noticeably increased and by March 1952, the total was 612, a number that remained more or less constant until 1957 when a Department of Defense "belt tightening" made slight inroads. Since then, the number of employees at NRDL has hovered between 575 and 600. On 1 August 1953, NRDL assumed responsibility for its own appointing authority and all civilian personnel functions were transferred from the Shipyard.

The scientific staff is now as diversified as the program and includes: chemists (organic, theoretical, analytical, physical, radiological); physicists (nuclear, thermal and theoretical); health physicists; engineers (chemical, electrical, electronic, mechanical, civil; mathematicians and computer programmers); operations research analysts; metallurgists; physiologists; biochemists; biophysicists; psychologists; medical doctors; pathologists; bacteriologists; hematologists; etc. Some of these are members of the Armed Forces, and many of the Laboratory technicians are hospital corpsmen.

In the support capacity are: laboratory assistants; administrators; technical publications specialists; illustrators; engineers; librarians; clerical workers; photographers; mechanics; experimental machinists; electricians; glass technologists; draftsmen; and specialists in communications, information, training, supply, and transportation.

Academic degrees held by members of the Laboratory are:

BA or BS	175
MA or MS	55
PhD	48
MD	6

Management personnel to the level of Division Head are:

SCIENTIFIC DEPARTMENT

Scientific Director	Dr. Paul C. Tompkins
Associate Scientific Director	Dr. Eugene P. Cooper
Assistant Scientific Director	Mr. Robert C. Lilly
Consultant to the Scientific Director	Dr. Claude R. Schwob
Statistical Consultant	Miss Marion Sandomire
Medical Consultant	Dr. Robert R. Newell
Head, Biological and Medical Sciences Division	CAPT Albert R. Behnke, Jr. (MC) USN
Head, Chemical Technology Division	Dr. Edward R. Tompkins
Head, Nucleonics Division	Dr. Andrew Guthrie
Head, Military Evaluations Division	Mr. Walmer E. Strope

COMPTROLLER AND MANAGEMENT ENGINEERING DEPARTMENT

Comptroller and Management Engineer	Mr. James E. Carroll

CIVILIAN PERSONNEL OFFICE

Civilian Personnel Officer	Mr. C. Bruce Moyer

MEDICAL DEPARTMENT

Radiological Medical Director	CAPT Albert R. Behnke, Jr. (MC) USN
Head, Radiological Health Division	LT Walter L. Taylor (MC) USN
Head, Health Physics Division	Mr. Albert L. Baietti

TECHNICAL SERVICES DEPARTMENT

Technical Services Director	CDR Jack A. LaSpada, USN
Head, Technical Information Division	Mr. Thomas J. Mathews
Head, Engineering Division	Mr. Valentine Franz, Jr.
Head, Logistic Support Division	LT Wellard R. Guffy, (SC) USN

ADMINISTRATIVE DEPARTMENT

Administrative Director	LCDR Clyde O'G. Morrison USN
Head, Military Personnel Division	LCDR Joseph S. Kelly (MSC) USN
Security & Communications Division	LT M. K. Romani (W) USN

Brief Biography of the Scientific Director

Dr. Paul Carter Tompkins is a native of Walla Walla, Washington, where he lived until he finished Whitman College, a chemistry major. Graduate study at the University of Chicago followed, and after a year or so he transferred to the Department of Biochemistry at the University of California to continue work for his doctorate. There he served as a teaching assistant until his PhD in biochemistry was received in 1941. The next two years he spent at Stanford conducting research in the development of a new method for measuring the stability of serum albumin from blood plasma.

Dr. Tompkins became affiliated with the Manhattan Project at the Metallurgical Laboratory in Chicago in 1943, working with the production of plutonium as the source material of the atom bomb. This was followed by his assignment as group leader, later senior chemist, in the Radiochemistry Section of Oak Ridge National Laboratory, Tennessee, his research concentrated on biological applications of radioisotopes and in the development of safe procedures for handling radioactive materials. He is an acknowledged expert in both these fields.

After four years at Oak Ridge, Dr. Tompkins came to NRDL, first as advisor to the Scientific Director, then as Associate Scientific Director in charge of the Laboratory's participation in Operation GREENHOUSE. In June 1951, Dr. Tompkins was appointed Scientific Director following the resignation of Dr. William H Sullivan, the first Scientific Director who had joined the Laboratory in January 1948.

Dr. Tompkins has a great many scientific publications to his credit and is active in such scientific societies as The American Chemical Society, Sigma Xi, AAAS and the American Industrial Hygiene Association. He served as consultant to the Joint Committee on Atomic Energy in connection with Congressional Hearings in 1957 on the nature of radioactive fallout and its effects on man.

The Scientific Director – Dr. Paul C. Tompkins

FACILITIES (Buildings)

From the "rented room" in the San Francisco Naval Shipyard, the embryonic Laboratory moved into Building 506, formerly occupied by the Shipyard Dispensary and described in the first Laboratory report as having "spaciousness and a floor plan ideal to accommodate the proposed personnel and equipment — at least for a 6-month development program." In the 9,711 square feet, there were two chemistry laboratories, a photographic dark room, several counting rooms, administrative and personnel offices, personnel decontamination room, a few store rooms, an instrument repair room, the library, and an assortment of other offices — a grand total of 27 rooms, all very small.

Even then, it was realized that any expansion would demand larger quarters, and by March 1948, two more buildings, 507 (an ex-barracks) and 510 (ex-Warrant Officers' Mess) brought the total floor space to 24,000 square feet. The animal colony was housed in 507, along with Health Physics, the Decontamination Center, Medical Services, and part of Supply. In Building 510, Physics, Auxiliary Services, Instrumentation, and the rest of Supply fell over one another.

Within a few months, the Laboratory had spilled over into several other Shipyard buildings, the largest being Building 351 (with 40,000 square feet of floor space). Some of the other buildings were quonsets devoted to instrumentation. Total floor space was now approximately 70,000 square feet. With the accelerated expansion of projects assigned the Laboratory, the need for space and more space increased. In the end, some 20 Shipyard buildings were gobbled up and it was necessary to construct two annexes to Building 351. Floor space now added up to 102,000 square feet.

New Building Becomes Reality

This growth precipitated an urgent need for a central building to collect most of the workers under one roof, and in 1950, the Bureau of Ships was requested to approve construction of a four-story building that would cost about $5,000,000.00. In January 1951, Representative Franck Havenner (Dem. - Calif.) introduced in the Congress HR1196 to appropriate $7,800,000.00 for construction of a permanent home for the Laboratory. In October 1951, the Laboratory was included in the Military Construction Bill for $8,580,000.00, and an office was set up for the architect Leland S. Rosener in Building 508 to begin designs to be coordinated by the Management Engineering Department.

When the plans were finished, progress was rapid. Bids from nine firms were completed on 9 June 1952, and two weeks later, the contract was awarded jointly to Contractors Rothschild, Weirick and Raffin and

Ground-Breaking by Rear Admiral Homer N. Wallin, USN

James I Barnes. The next move was to clear the site adjacent to the South Gate of the Shipyard, then occupied by the Navy Commissary Store.

All was in readiness within a month and on 30 July 1952, ground for the long-awaited building was broken by RADM Homer N. Wallin, USN, then Chief of the Bureau of Ships.

At the ceremony witnessed by a number of high ranking officers and scientists, Admiral Wallin spoke prophetically of the importance of the contribution of the Laboratory. "It is the only laboratory of this kind in the world." he said, "and is important not only from the viewpoint of warfare, but also for its humanitarian aspects. Certainly much of the information necessary for the utilization of atomic power will have to come from this Laboratory, and its importance to industry will become greater and greater..."

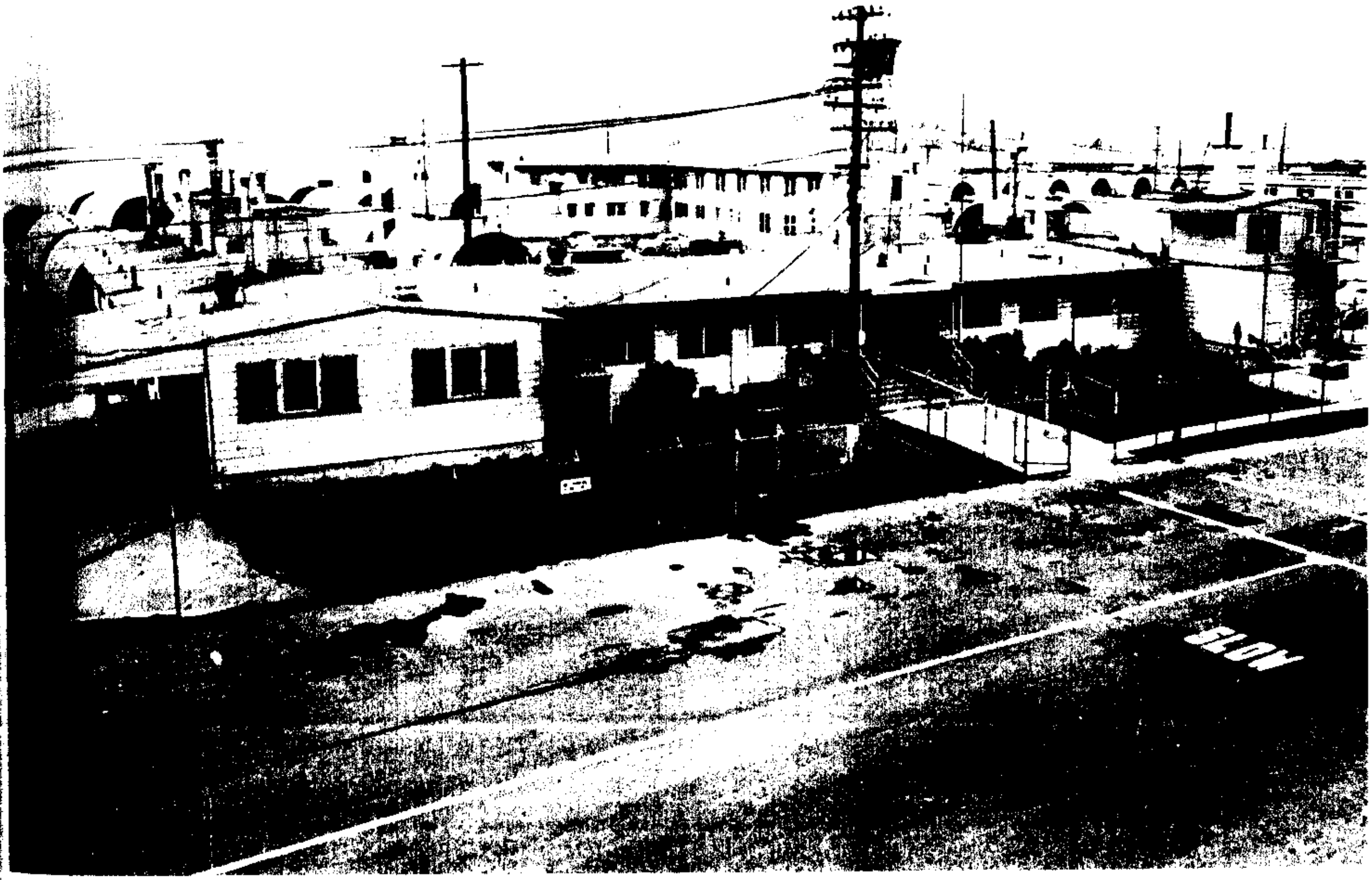
Features of the New Building

The unique building for a just-as-unique activity has six stories of steel and reinforced concrete, with overall dimensions of 400' x 100' and floor space of 282,000 square feet, nearly 30 times as great as the Laboratory's initial space! There are no windows except at the entrance and in the roof-top cafeteria. The omission of windows was an economy measure with several other advantages. Greater useable space is provided the laboratories, adding about 10 percent wall space, and making placement of furniture and fixtures more flexible. Illumination is more uniform and temperatures can be kept more constant (an important item with experimental animals). Greater protection is afforded from blast, in fact, the Laboratory is considered a Class I shelter, capable of protection from radioactive fallout and blast over-pressures up to 10 pounds per square inch. In lieu of windows, the interior is made cheerful with pastel walls, the shades chosen for harmony and habitability to produce a pleasant atmosphere in which to work.

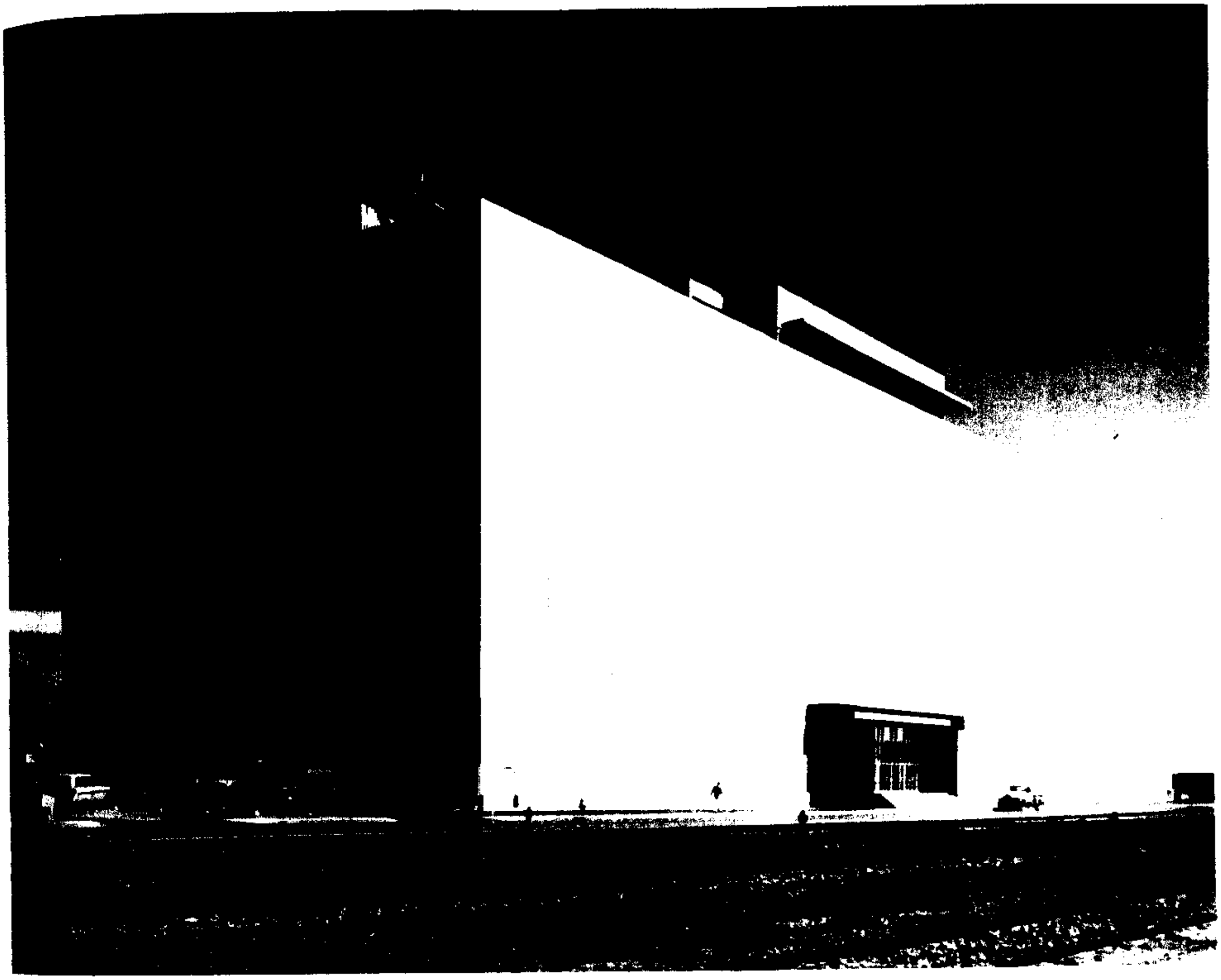
Other modern features include: interior walls of pressed metal, movable to facilitate relocation as necessary; asphalt tile floors; escalators for easy movement among floors; passenger and freight elevators; and specially designed ventilation, with independent systems for each floor to aid in maintaining a uniform pressure balance. Fibre glass and chemical filters are used in the exhaust system in certain areas; the 274 - seat auditorium and the cafeteria have air circulating systems completely isolated from the main system.

Adjacent to the main building is a smaller one of similar construction which, completed in 1954, houses the 2-million electron volt Van de Graaff electrostatic accelerator. This building is also completely air conditioned, two stories high, divided into ten rooms, with the generator

Laboratory Buildings — The First Home


SLOW

The New Laboratory Home



on the upper floor and the target room, experiment area, laboratories, control console, machine shop, office and rest rooms on the lower floor. A 4-foot thick, 30-ton shielding door for bringing in large equipment for experiments is at one end. When open, it permits the adjoining closed area to be used as a 100-foot gamma-ray range.

Other facilities located in various parts of the Shipyard include one building entirely devoted to the housing of experimental animals plus one for holding animals and still another for psychological studies; a building for storing isotopes that are issued for individual experimentation; a hot cell with special shielding and waste disposal features for work with radioactive materials at high levels; a building for changing to and from special protective clothing; a beached barge converted to a laboratory for realistically testing effects of radioactive contamination on various materials and surface coatings; a building that houses a 1-Mev X-ray machine; a hollow concrete block used for sample storage; and a portion of one building used for field test sample processing and storage.

Late in 1958 three new projects involving additional facilities were begun. Ground work was laid for use of certain buildings and land areas at Parks Air Force Base, which is being turned over to the Army, for research that will begin in 1959. An animal holding area for large domestic animals was constructed toward the periphery of the Shipyard. In December storage space was transferred from San Bruno to Islais Creek, adjacent to the Shipyard, to save time and transportation costs.

EQUIPMENT

From the "two working Geiger counters and one coffee pot", the pioneers soon developed ways and means to get modern equipment essential for operation of this type of laboratory. In its initial stages the Laboratory actually owned only one alpha counter; everything else was borrowed from the Manhattan District. Rumor said that the borrowed equipment might be "written off," but the Laboratory officers held out for purchase of new, accurate and reliable instruments. A good portion of the first funds appropriated for the Laboratory was earmarked for them, with the requisitions held until the "last minute" to take advantage of latest developments.

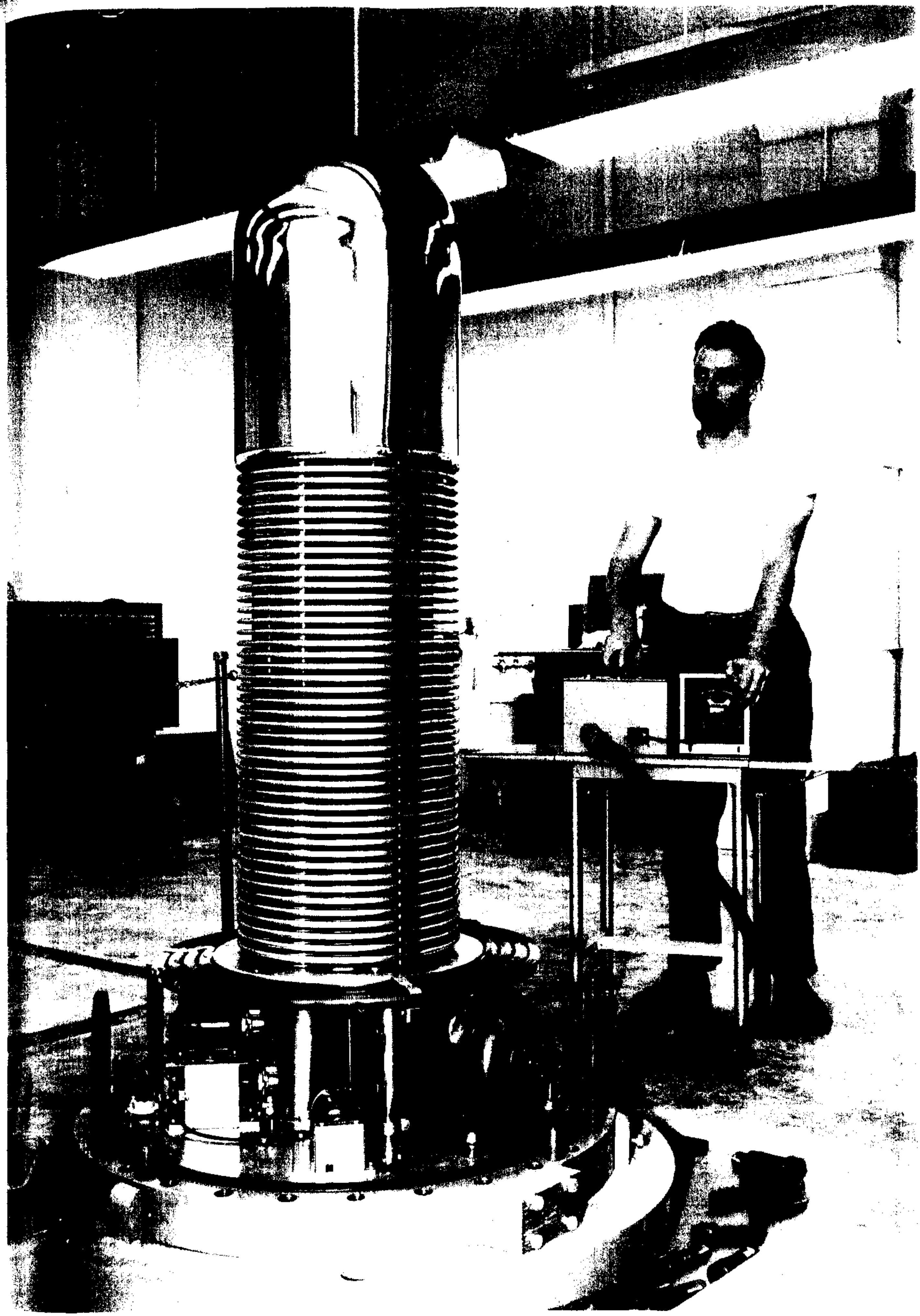
Apparatus for the production of radiation had top priority and included: a portable 250 kilovolt X-ray machine for animal irradiation; a 15-curie cobalt source capable of delivering a gamma-ray dose of 1 to 40 roentgens per hour; a kevatron, an electron accelerator designed and built at the Laboratory to simulate conditions resulting from an atomic burst; and a 250 Kev constant potential X-ray machine for use in determining the response of radiation detectors to X-rays of varying energy. In addition to its own equipment, other nuclear irradiation facilities were available to the Laboratory, for example the University of California's Donner Laboratory cyclotron and a 1,000 kilovolt X-ray unit of a local industrial firm.

Other items of equipment added in the first few years as funds permitted were: carbon arc searchlights for production of intense thermal radiation; kymograph and accessories; beta-gamma spectrometer used to obtain information regarding the energies, decay rates and intensities of beta and gamma rays from radioactive materials; high frequency vacuum tube voltmeter, automatic size-frequency particle-size analyzer for measuring size frequencies of dust dispersion collected from atomic bursts; infra-red spectrophotometer; and climatic simulator valuable in the design of electronic equipment which must withstand extreme temperatures, humidity and altitudes. Other items for specialized research were: optical spectrograph for the analysis of radioactive dusts and for determining impurities in radioactive substances; Cary recording spectrophotometers for determining the chemical nature of contaminants; gas absorption apparatus for determining the absolute surface area of materials such as oxides; coincidence counter for calibration and standardization of radioactive sources and of detecting equipment; smoke penetrometer for testing filters; X-ray diffraction unit to determine the compounds present in aerosols resulting from atomic bomb bursts; isotope-ratio mass spectrometer for biological tracer with elements that are either not radioactive or are inconvenient to use with radioactive isotopes; and electron microscope used in measuring particle sizes of finely divided samples from atomic bomb bursts and also for examining tissue sections of various organs. In addition to those described are various other instruments such as electro-cardiographs, ultracentrifuge, electrophoresis apparatus, ultrasonerator, Warburg apparatus, refrigerated centrifuges, etc.

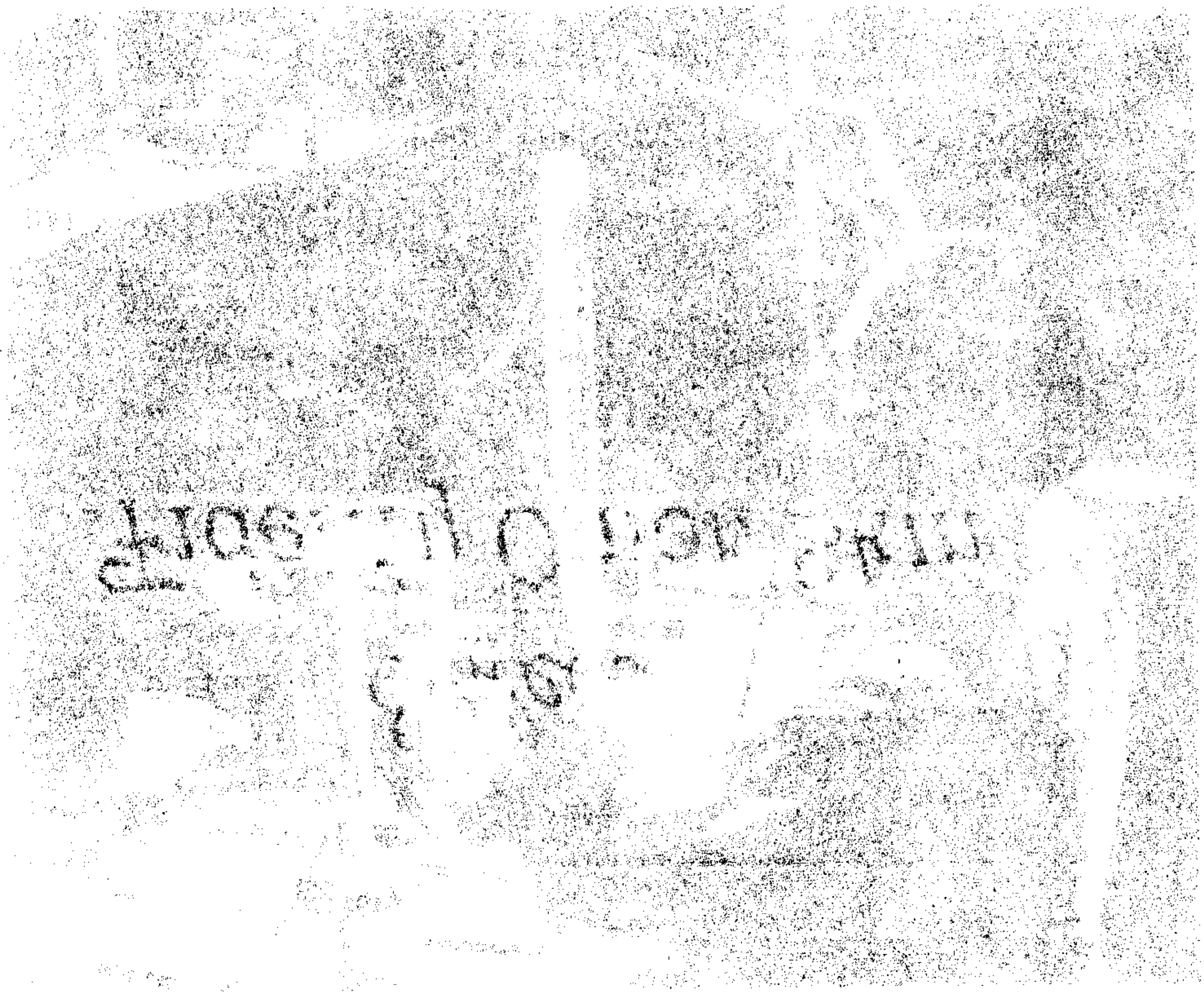
Large Generator Added

The 2 mev Van de Graaff electrostatic accelerator purchased in 1955 gave fresh impetus to the Laboratory's research. Each scientific division has acquired the most modern devices to assist in studies peculiar to its areas of interest and responsibility. These include many types of high intensity gamma radiation sources, different sizes of climatic simulators, multi-channel pulse height analyzers, scintillation spectrometers for use in laboratory or field; semi-trailers for field test use; several radiac calibration ranges; thermal radiation sources plus related equipment; a salt-spray and sunlight simulating cabinet; horizontal and vertical shake tables; additional animal irradiation equipment; electrophoresis-diffusion apparatus; several remote handling devices; various radiological and radiochemical counting devices, and a great deal of miscellaneous equipment to implement the approach to the multitudinous problems of nuclear defense.

The 2 Mev Van de Graaff Accelerator



Ready Supply Store, NRDL's "Super Market"



Glass Blower in Action

In September 1956, a one-million volt X-ray machine was installed for the deep radiation effects program. Less than a year later, approval was received to proceed with the preliminary design of a cyclotron, a high flux neutron source which will require at least two years to construct. Most recent of the equipment is the Datatron electronic computer which was installed in May 1958. A Computing Branch was established to consult with investigators in the design of experiments, problems, programming and coding.

Practical Facilities

Two very useful facilities in the Laboratory are the Glassworking and Precision Instrument Shop where apparatus for scientific experimentation is constructed according to investigators' specifications, produced often from very crude drawings; and the Ready Supply Store which lives up to its name by having supplies on hand to fill every need from the office to hard-to-get chemicals, transistors, and other materials needed by the scientist.

Laboratory Developed Equipment

The Laboratory has long had a major interest in the design, development, and evaluation of radiac instrumentation, not only for its own use but for Navy-wide applications. Among the first developments were the beta-gamma spectrometer and the automatic particle-size analyzer. A practical inexpensive dosimeter for measuring radioactivity brought an award in 1955 to the scientist who tested it for acceptance by the Navy. Some other significant developments have been:

1. The RAS-10 Alpha Survey Radiac. This instrument, utilizing scintillation detection, is intended to fill the Navy's requirements for a field alpha survey radiac capable of extended operation under difficult environmental conditions. The unit is completely transistorized and operates from two standard flashlight cells, it covers a range from 0 to 1,000,000 counts per minute, corresponding to a range of 0 to 10,000 micrograms per square meter of plutonium.

2. The RGG-10 Low Range Survey Meter. The RGG-10 is a low range beta-gamma survey radiac operating from two standard flashlight cells. Printed circuitry is used throughout, and the unit is completely transistorized. It covers the range from 0 to 500 mr/hr in four separate ranges. Beta indication is provided on all ranges with a side window beta capability for personnel monitoring on the two lower ranges.

3. The IM/153 Radiac Dosage Alarm. This unusual unit provides a digital display of integrated dose to a maximum of 1000 roentgens in

steps of 1/10 roentgen per dose rate from 1/10 r/hr to beyond 500 r/hr. The unit is quite small, weighing about 3 pounds. It is a hybrid transistor-tube circuit operating from flashlight cells. A pre-settable audible alarm is provided.

4. The AN/PDR-52 Beta Survey Radiac. This unit, like the one previously discussed, is based on an NRDL developed prototype. This instrument is a multi-purpose device, providing high range beta measurements, beta + gamma measurements and gamma-only measurements. An unusual feature of the unit is its beta-only capability which utilizes gamma cancellation. This feature permits decontamination operations to proceed efficiently in a high general gamma field. The instrument covers the range from 0 to 1000 rep/hr in three separate ranges for each of the above functions.

5. The AN/SDR-1 Shipboard Radiac System. This is a fixed-installation shipboard radiac system covering the range from 0 to 1,000 r/hr full scale in eight decades. The top four decades are transferred to remote readout stations. There is also provision for a pre-set warning alarm on the lower four ranges. Power is ordinarily supplied by the ship's AC lines with provision for 50 hour standby operation from self-contained storage batteries.

6. The AN/PDR-44 High Range Radiac. This instrument, based on an NRDL prototype, covers the standard military high range from 0 to 500 r/hr in three ranges. It is an ionization chamber device operating from one flashlight cell and utilizing an extremely stable dual electrometer tube. A beta capability is also provided.

7. Gamma Intensity Time Recorder Systems. The Model 103 GITR is a self-contained battery operated instrument which records gamma intensity as a function of time upon magnetic tape for unattended periods extending up to 60 hours. It covers the range from 10 mr/hr to 10^5 r/hr in two ranges overlapping at 10 r/hr. A time reference is also recorded on magnetic tape at the rate of 16 pulses per minute on a third channel.

SCIENTIFIC PROGRAM

On 19 November 1946, the day after the Laboratory for Radiological Studies was established, a memorandum announced a "crash" program for: coordination and improvement in the techniques of decontamination; procurement of permanent facilities and equipment; simultaneous creation of positions, writing of job specifications and procurement of technical personnel; clearance to receive necessary reports of the Manhattan District; and provision made for a classified library for their safekeeping.

Engineer shows Laboratory-developed instruments to Japanese military officers


HIGH RANGE
GAMMA
SURVEY METERS

Problems of the pioneers at NRDL were legion – difficulty of berthing "hot" ships; lack of crane service for removing radioactive materials; rigid shipping regulations; and many others. The handling of arriving radioactive material by the uninitiated required adherence to strict rules to avoid exposure to dockside personnel, and the test materials had to be placed in an isolated, locked portion of a warehouse. A report of the radioactive status of all shipments had to be stapled to the advance bill of lading to warn the consignee. Considering the infinite care and precautions observed, and the fact that all operations were carried out under strict security provisions, the work went forward with astonishing rapidity.

Early in 1947 the immediate studies were defined as centering on development and testing of suitable removal methods and agents; appraisal and standardization of radiation detection instruments; and examination of fissionable materials and their distribution on the ships. Long term studies were concerned with the concentration, scattering, adsorption factors and distribution of fission products on various surfaces and on such materials as steel, plastics, ceramics, cordage, etc; safety training devices; measuring instruments; development of ways to simulate in the laboratory the effects of nuclear attack; development of techniques for handling large quantities of contaminated materials, and of protective coatings.

The Program is Organized

The first recorded specific program was issued in 1948 showing eight master areas of research: (1) Contamination and Decontamination; (2) Handling and disposal of radioactive materials; (3) Theoretical studies and calculations; (4) Dosimetry; (5) Personnel Protection; (6) Biological Studies; (7) Medical Studies; and (8) Instruments, Instrumentation and special apparatus. Each of these included many subtasks. This program was revised late in 1949 to the following:

(1) Characteristics of Hazardous Radiations and Radioactive materials, including airborne and surface contamination; environment and history of contamination; nuclear and thermal radiation characteristics; measurement of radiation dosage.

(2) Personnel Hazard including lethal and sublethal dose studies – acute and chronic exposure to internal radiation; physiological and anatomical effects of ionizing radiations; biochemical changes following irradiation; maximum permissible dosage; hazard from airborne contamination.

(3) Appraisal of situations and effectiveness of countermeasures, involving the current status and relative importance of countermeasures and analysis of operational feasibility of decontamination.

(4) Radiac instruments, mechanisms of radiation detection; individual and group warning and alarm instruments; instrument test devices; analytical instrumentation; and evaluation of equipment.

(5) Protective measures, including coatings; properties of new materials and methods; anti-contamination protective devices; individual and collective protection of personnel.

(6) Reclamation measures, including physical and chemical methods, specifications and standards for equipment, personnel and procedures; handling and disposal of contaminated residues (waste); reclamation of bulk materials.

(7) Medical diagnosis and treatment, consisting of prophylactic and therapeutic studies; complications and complicating factors in radiation injury.

(8) General projects covering preparation of manuals and information surveys; planning and preparation for future Nuclear Weapons tests; design of scientific equipment and facilities.

Not actually a part of the scientific program, but in support of it were services provided by groups such as Health Physics, Medical Services, Auxiliary services and Technical Information.

Scope of Program Widens

Through the years the scientific program has continued along similar lines, broadened to carry on both basic and applied research in the various problems inherent in the field of atomic defense. Starting in 1958, the Laboratory progressed to long range planning of its research. The proposed Technical Program for FY 59 was presented in a format that not only gave detailed proposals for that year, but also showed a charted path of research for a five year period into the future. The philosophy underlying this approach is a three-fold one:

(1) As the nation's expert in the field, the Laboratory deems it a moral and inherent responsibility to maintain a continuing review of the state of knowledge in the areas of its mission, and, as a corollary, to highlight the areas of ignorance ahead as it sees them.

(2) Similarly, the Laboratory deems it a responsibility to coalesce the demands of its many sponsors and the thoughts of its own scientists into a coherent technical entity, a program designed to probe into those areas of ignorance. Budget limitations, availability of personnel, "crash" programs, the inability always to match competence and facilities with need – all combine to preclude the program of any one year from being a perfect technical entity. Nevertheless, an attack on a long range scale is

feasible and can be accomplished through planning. The area that cannot be explored this year can, through planning, be explored the next – or the next.

(3) As a by-product of this long range planning, it is hoped that a portrayal of an orderly and planned research attack might well help crystallize the thinking and planning of the Laboratory sponsors. The presentation of the over-all picture is more than can be implemented in any one year, but from that picture the sponsors, knowing their most immediate needs can then give support to those phases they consider the most urgent at that time.

So far the results of this plan have been encouraging. The scientist can see where he is going. The sponsor can see what part his program plays in the whole attack on the problems of radiological defense and can view the attack in phases rather than in yearly increments which usually are staccato and somewhat uncoordinated. Finally, Laboratory management can plan its programs on a continuing basis with better assurance of timely funding, the lack of which is one of the hazards of government support research.

Current Program

In its growth and development the seven broad phases of the scientific program now cover:

(1) Determination of the characteristics of harmful radiations and radioactive materials.

(2) Study of atomic explosion phenomenology and weapons effects.

(3) Study of hazards of nuclear radiations to personnel.

(4) Development of instruments to detect, identify and measure radioactivity.

(5) Development of countermeasures for removing radioactive contamination and for minimizing or preventing contamination.

(6) Study of measures to minimize harmful effects of nuclear radiation on human beings.

(7) Study of physical and biological effects of thermal radiations accompanying nuclear weapons detonations.

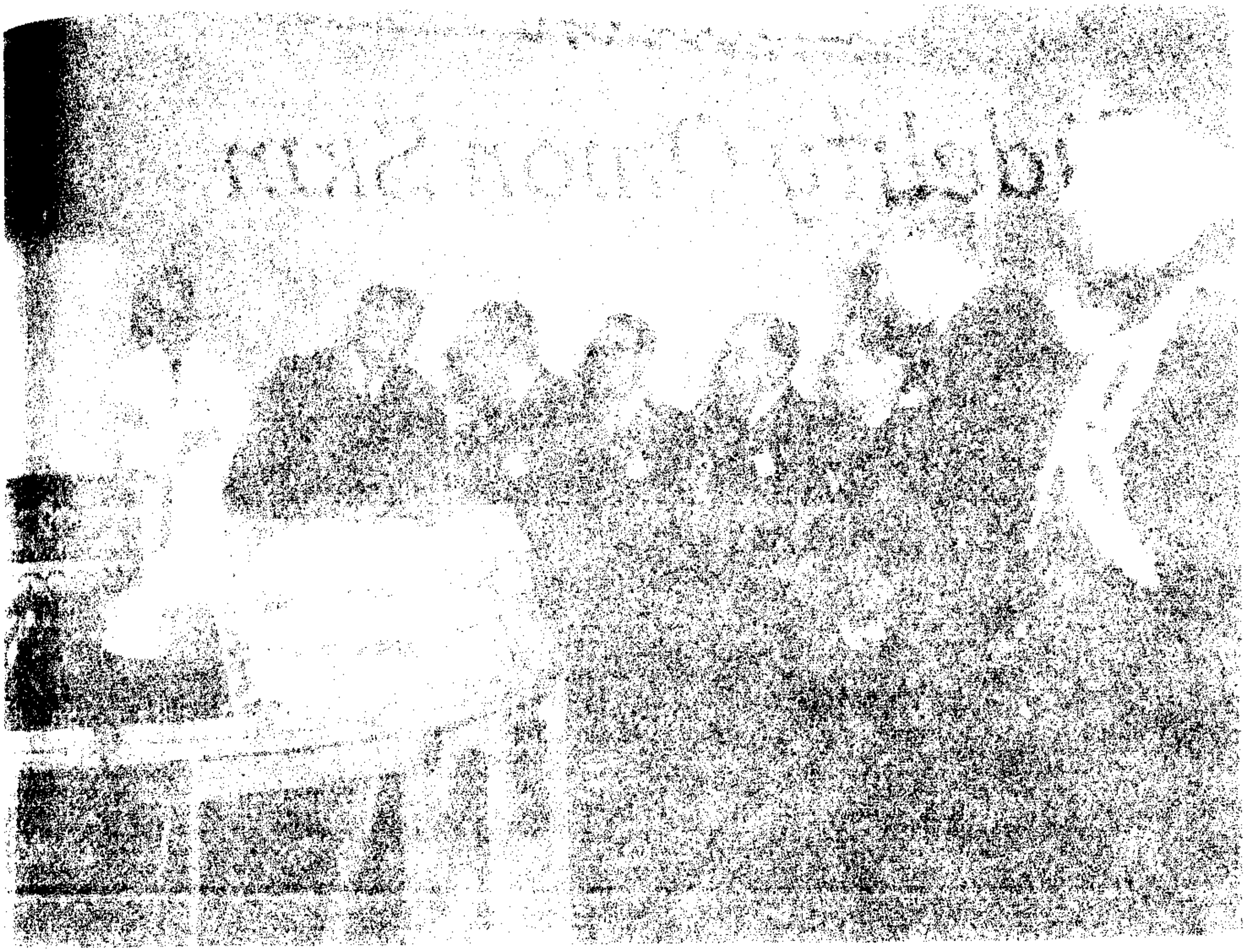
Charged with carrying out these studies are the four scientific divisions.

Biological and Medical Sciences. This division is involved with problems of injury to personnel resulting from nuclear and thermal radiation. From the earliest days of the Laboratory, biologists and doctors of medicine have been studying the complex relationships between radiation and the organism. Experimental animals, mostly rats and mice, have been used in a great variety of basic studies, most of which are too esoteric for discussion here. The general aim of this work, however, is to learn the nature of radiation injury, how to prevent it, and how to treat it, ultimately in the human.

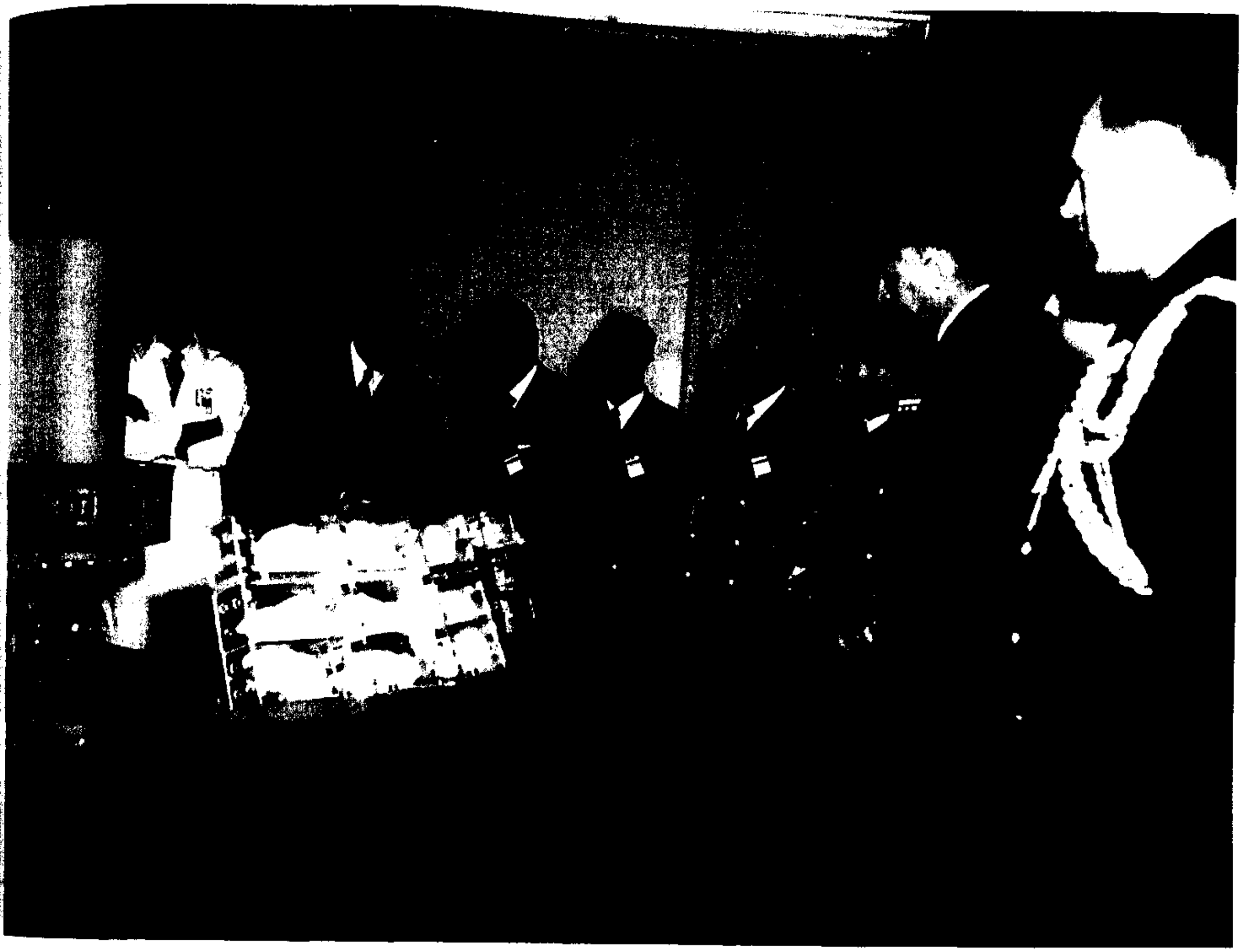
Early difficulties and disappointments with animal studies at Operation GREENHOUSE and BUSTER/JANGLE led to the development of laboratory radiation sources for greater economy, efficiency, and control of experimental variables. These sources include many emitters of nuclear radiation as well as two particularly satisfactory thermal sources – the Mitchell carbon arc, whose energy is usually emitted in the form of a standardized simulation of a nuclear weapon's thermal pulse; and the 30-inch searchlight, whose energy, about three times that of the Mitchell, is normally controlled by a precise square-wave shutter on which staff members hold a patent.

Studies of rat skin burns developed into investigation of more profound systemic effects such as erythrocytic fragility and led to the first Thermal Burn Conference, held at NRDL in 1953. They also were expanded to include burns from beta particles from P^{32}, a Sr-Y plaque (with a longer half-life than P^{32}) which produces about 25 rads/sec, and electrons from the Van de Graaff accelerated over a wide energy range - from the machine's upper limit of 2 Mev down to levels at which the electrons will penetrate skin only to a depth of 100 microns. Volunteers have exposed themselves to first degree thermal burns and, with the required approval of the Secretary of the Navy, to low-level beta radiation, attempting to add to the small store of data on the human. At present, long-term inter-species comparisons using large mammals are under way, particularly with neutrons, again in an attempt to extrapolate, eventually, to the human. In vitro studies of the inhibition synthesis of DNA (a basic cell material) by sodium ions, which as among the products of ionizing radiation, are of interest to the cancer researcher. Studies of avoidance conditioning, wherein animals will quickly learn to avoid a place where they were given low doses of x- or gamma radiation, raise interesting questions about their sensing the presence of radiation. Other work has shown that the liver, thought to be insensitive to radiation damage, shows a high percentage of mitotic anomalies when cell division is accelerated. Successful inter-species transplants of skin and bone marrow are provocative to those studying radiation therapy.

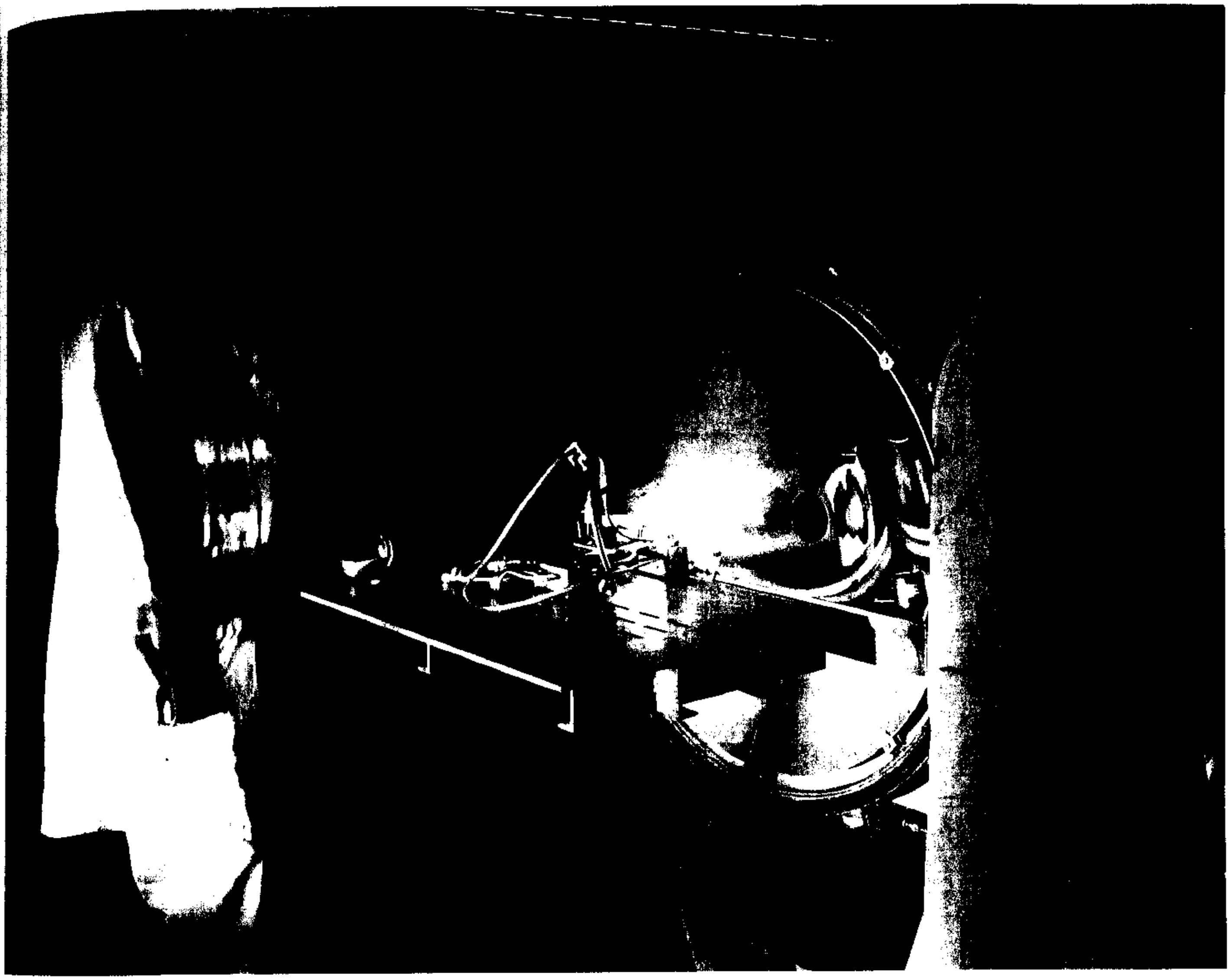
Nucleonics. This division makes investigations associated with nuclear reactions including studies of their characteristics and behavior; and evaluation, design and fabrication of radiac instruments. Working closely with the biologists, the physicists have developed sources and instruments to detect and measure the thermal and nuclear radiations.



BIO-MED — The Radiological Medical Director explains a radiation source demonstration to distinguished visitors from South America



NUCLEONICS — Demonstration of the 36-inch high intensity carbon arc thermal source



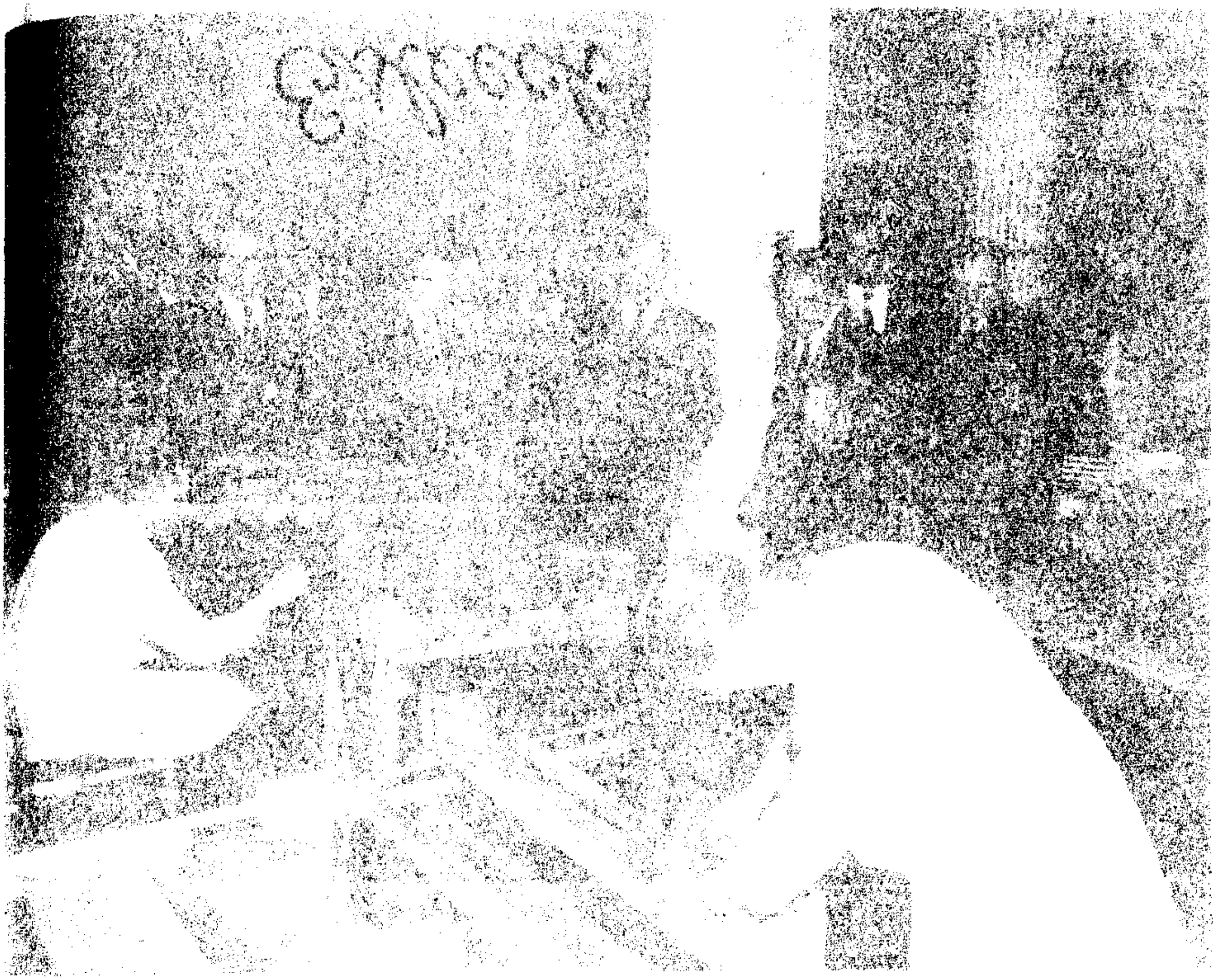
They have also carried out a continuing program of studies, characterizing and defining the various energy forms released by nuclear detonations and their effects onphysical materials. A long series of thermal observations at nuclear weapons tests in Nevada and the Pacific are currently being summarized for publication.

The physical characteristics of thermal radiation have been adequately defined for all yields at the lower altitudes for operational purposes, i.e., damage effects can be confidently predicted. Current studies emphasize environmental variables such as atmospheric attenuation and scattering by clouds. Basic studies of ignition phenomena, using controlled thermal sources and a standard fuel developed by Forest Products Laboratory, have been made. Other studies of high-temperature effects on materials are related to missil development problems.

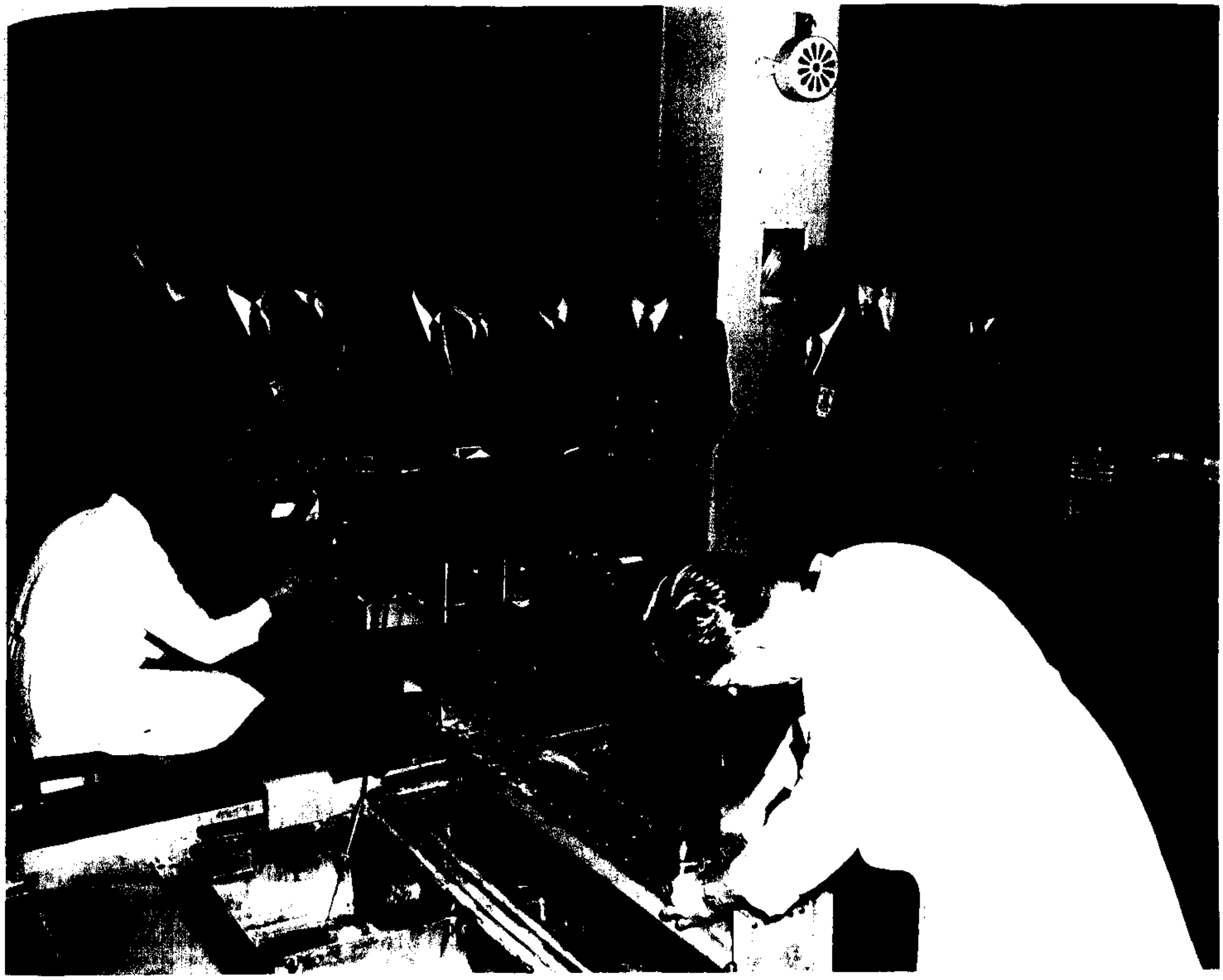
A long series of studies on gamma penetration through steels has led to experiments carried out on an aircraft carrier and a destroyer to verify, extend, and correlate with the laboratory and theoretical studies. Another continuing program has studied nuclear radiation damage to dielectric materials in an attempt to find better insulating materials for use in the high radiation fluxes around reactors.

Chemical Technology. This division develops practical methods, equipment and procedures for decontamination and for minimizing contamination. It has developedand applied many new analytical techniques and methods for more rapid determination of fallout constituents. Sequential ion exchange permits analysis of a single sample for many elements instead of having to use a separate aliquot for each element. Polarographic separation techniques developed here permit the very rapid radiochemical determination of many radionuclides from fission product mixtures. In the process of separating rare-earth fission products, several previously unknown fission products were discovered in the right wing of the fission yield curve. Many physical and chemical reactions occurring in the actual fireball have been described, as have very early-time decay processes. Standard analytical instruments have been modified and applied to the determination of the nuclide mixtures in fallout. The Laboratory published, first in 1949, with a revision in 1956, the definitive work on theoretical growth and decay for each fission product chain of interest.

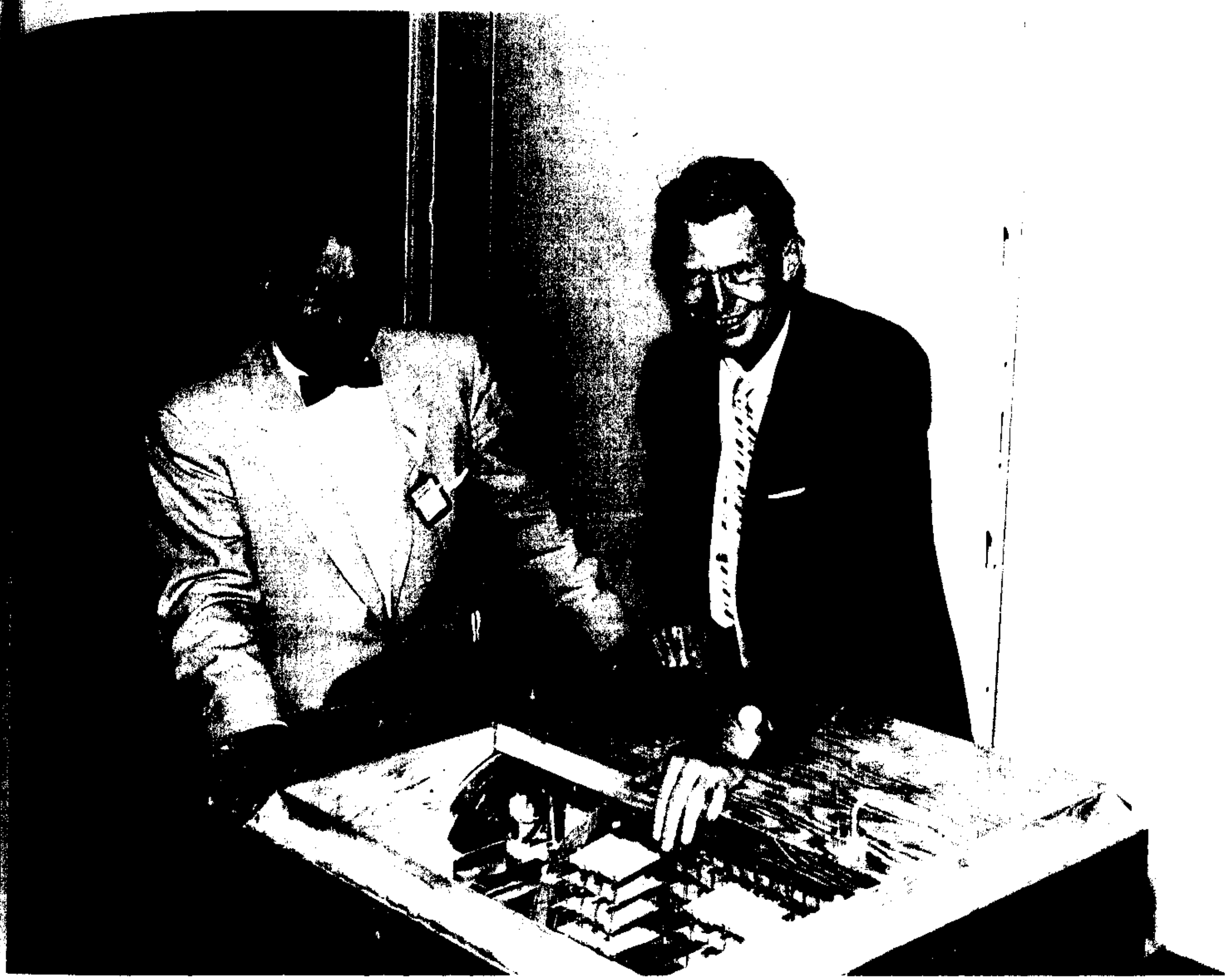
Military Evaluations. This division conducts research on the evaluation and interpretation of scientific information in terms of military problems and needs. There is often a gap between specific technical findings and their applications to operational problems. The Laboratory has become increasingly involved in operations analysis, wherein detailed laboratory and field experiments are collated and recommendations made to sponsoring agencies toward solutions of their applied problems. Some of the major studies of this type have reported on base evasion maneuvers; gamma radiation hazard to submarines near a deep under water burst; personnel radiation hazard to air crews exposed to the



CHEM-TECH – The Commander-in-Chief, Atlantic Fleet, Admiral Jerauld Wright, and members of his Staff hear a description of the transport of contaminant by water films



MILITARY EVALUATIONS — The Model Shelter designed at NRDL
Mayor of Salt Lake City and Scientific Director



ADDENDUM

ANNUAL HIGHLIGHTS

Since it is sometimes difficult to place an occurrence properly in time, the following summary of important events or progress in the life of the Laboratory is chronologically listed:

1946 – Laboratory for radiological studies established as activity of BuShips and part of the San Francisco Naval Shipyard.

1947 – Move to Bldg. 506 – Established as Radiation Laboratory of SFNS and separated from the Industrial Laboratory – First sponsors – First Mission defined – Simple organization chart proposed – First Progress Report – Change of Command, LT Preston to CDR Fee – Civilians added to staff.

1948 – Mission restated – First Boards and committees formed – Acquired additional Shipyard buildings – First recorded specific scientific program – Name changed to Naval Radiological Defense Laboratory – First glass apparatus made – Dosimetry program organized – BULLETIN initiated in February as "Technical Director's Bulletin"; changed to "Scientific Director's Bulletin" in October and to "Laboratory Weekly Bulletin" in November.

1949 – First formal organization chart – Laboratory operated as a regular work day on a Saturday to greet the Research and Development Board's Committee on Atomic Energy. Enthusiasm of the Committee resulted in a visit the next week by the Under Secretary of the Navy – Scientific Director appointed to National Committee on Radiation Protection.

1950 - Made separate activity and name modified to "United States Naval Radiological Defense Laboratory" - New building requested - Assistance with radium spill on Treasure Island - Change of Command, CDR Fee to CAPT Bird.

1951 - Organized into departments -- Field Operations GREENHOUSE, RANGER, BUSTER/JANGLE - Firsts: Laboratory patent, lab-wide seminars, newspaper publicity, exhibit, radio program and Lab movie - New building approved - Change of Scientific Director, Dr. Sullivan to Dr. Tompkins.

1952 - Building 351 completed and occupied - Ground broken for new building - Field Operations IVY, TUMBLER/SNAPPER - Administrative Manual produced - Assistance with nuclear accident at Chalk River, Canada - NRDLERS' Handbook initiated - Wider publicity received - Increased participation in scientific meetings - Bowling and golf tournaments - Carolers.

1953 - Awards program moved from SFNS - Field Operation UPSHOT/KNOTHOLE - First Thermal Injury Symposium - NRDL speakers in demand - First Lab TV program - Guards transferred to NRDL - First Safety awards - Change of Command, CAPT Bird to CAPT Hinners.

1954 - Van de Graaff building completed (Held Open House with 600 visitors) - Field Operation CASTLE (Washdown proved effective) - Provided members for medical team to care for people exposed to fallout in Pacific - Meeting of the National Research Council Committee on Naval Medical Research - Visited by CNO and Chief BuShips and many other high ranking individuals - Bowling team won League pennant.

1955 – Detailed mission defined – Laboratory building completed and occupied – Established as separate command – First Open House – Dedication – Initiation of Scientific Director's Colloquia – Field Operations WIGWAM, TEAPOT – First scientific exhibit constructed – First summer employees – Self-Service Store (later Ready Supply Store) established – First Superior Accomplishment Award – WE of NRDL organized.

1956 – "Success Story" on TV – Field Operations REDWING, STONEMAN – Participation in Congressional Hearings on Civil Defense – Second Open House – 1 Mev X-ray machine installed – Change of Command, CAPT Hinners to CAPT Mandelkorn – Shielding and Liver Symposia – Step-up in TV programs – Accelerated participation in scientific meetings and in numbers of guest speakers – Piano presented by WE of NRDL – Golf tournaments.

1957 – Scientific Director promoted to high level position – Authorized to classify Laboratory positions – Participation in Congressional Hearings on National Shelter Program – Two Changes of Command CAPT Mandelkorn to CAPT Schultz, and CAPT Schultz to CAPT McQuilkin – Co-Op Program initiated – Field Operation PLUMBBOB – First Medical Symposium – Lab-wide exhibit constructed – Marked increase in publications in scientific journals and in papers given at meetings – Publicity received on killer clams, high altitude radiation studies, atmospheric scattering experiments, shelters.

1958 – Associate Scientific Director promoted to high level position – Small changes in mission – Long range planning of research initiated – Field Operations HARDTACK and STONEMAN – Model Magnet and Datatron installed – PLUCON team activated – Plans prepared for facilities to control and monitor laboratory wastes – Negotiations begun for use of Camp Parks areas – Plans for Hydra Series – New irradiation and analyzing equipment acquired – Completion of Vol I of "Radiation and Contamination Control" – Lab played host to several group meetings and many important persons – Awards of NSF Fellowship and Radiological Society Gold Medal – Training emphasized – Provision made for NRDL Fellowships – Pattern of increased publicity sustained.