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Paper prepared for presentation to the Society of American Archivists on August 29, 1996 by Myra O'Canna, Archive Coordinator, Sandia National Laboratories

Thar's Gold in Them Thar Notebooks: Benefits of Laboratory Notebooks in the Government Archive

As Archive Coordinator for Sandia National Laboratories Corporate Archives, I am responsible for promoting the preservation and value of Sandia's history. Today I will talk about one important part of Sandia's historical record--the laboratory notebook. I will start with some brief background on Sandia National Laboratories, including the Laboratories' mission and an example of how the gold in one lab notebook helped to give a picture of Sandia's early history. Next, I will talk about the use of notebooks at Sandia Labs, how they represent technology developed at Sandia, and include noteworthy examples of how patent information has been collected, used, and released to the public. Then, I will discuss how the National Competitiveness Technology Transfer Act of 1989 authorized technology transfer initiatives and the exclusive use of patented information, resulting in many golden opportunities for the national laboratories to work with private industry to further technology.

I will briefly discuss laboratory notebook retention schedules and mention a new initiative to better utilize Laboratory notebooks. And, finally, I will summarize how the "gold" in laboratory notebooks in government archives are a reflection of the valuable and extensive research authorized and funded by the government to benefit the public.

Vugraph of modern Sandia

Sandia National Laboratories is a government-owned, contractor operated, multiprogram laboratory operated for the Department of Energy (DOE) by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation. Sandia supports the DOE's mission objectives: national defense, energy security, environmental integrity, and economic competitiveness through a strong base in science and technology.

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DISCLAIMER

28 Sept thru 8 October: Trip to Calif.

#

10 October 1945: Called Sgt. Scharin ext 82 re rent. She will wait until I go on U.C. payroll. I will send Capt. M.C. Webb memo re Aug & Sept. earnings. ✓

#

Copy #90. AORG "The Use of Shore-Based 10 cm Radar for Watching Ships and Aircraft" - Loaned to C H De Selm

25271

11 October 1945: Major Parker: Will get Harry Allen to bring SCR-2[illegible] trucks from Trinity to Y.

#

13 October 1945: Visited TD site to determine if Z-1A work could be run there satisfactorily on temp. basis. Reported affirmatively to RS Warner.

#

15 October 1945: Group Z-1A meeting (#1) Corson, Fowler, Eissen, Ira Vincent, Walker, De Selm, Staley, McCord, Anderson

1. Corson reported Gen. Farrell assures $1,000,000 for Sandia but in month to month appropriation.
2. S.E.D.'s who are going to take courses at U. of N.Mex. will have to move soon.
3. What is Kirtland field policy re em? Hospital;
4. Section leaders give me memo re how they could operate from TD site. What changes & equipment would be required.
5. Anderson wants trailer, but not sure which one.

#

17 Oct 1945: Sandia

1. Major Jacquet says C-45 (Fuming) #447431 is being brought down from W-47 this week.
2. Capt. Kuntz:
   - a. Will send binoculars to me as soon as trailer unpacked.
   - b. Wants to know if some arrangements can be made for deep-sea disposal of 100,000 lbs. of 1222 LB castings now at W-4[illegible]
   - c. Will get N-7'S overhauled.
   - d. Will try to get SCR-299 trucks & trailers from Trinity.
3. Lt Riley will have questionnaire for me Friday AM.

#

R S Warner replaces J R Zacharias as Div-Z Chief.

Traditionally, Sandia's primary mission was design of nuclear weapon components and subsystems other than the nuclear physics package, that is the nuclear explosives, designed by Los Alamos and Lawrence Livermore National Labs. In essence, Sandia "weaponized" the nuclear systems designed at its partner laboratories. In the post-cold war years, Sandia's weapons responsibilities have evolved to include stewardship of the nuclear weapons stockpile. Sandia employs 8,300 people at sites in Albuquerque, New Mexico; Livermore, California; Tonopah Test Range, Nevada; and Kauai Test Facility, Hawaii. Of these employees, approximately 40% are employed in science and engineering.

Now, to back track a bit, Sandia's roots go back fifty years. In 1945, a desire to separate the production engineering of nuclear weapons from research and development resulted in the deployment of personnel remaining from the Manhattan Project in Los Alamos, NM to Albuquerque's Sandia Base to form Z Division of Los Alamos. Z Division was functioning by September 1945 and was the nucleus from which Sandia evolved.

Glenn Fowler documents these events in his lab notebook. Fowler, a young radar and ordnance expert, was aboard a B-29 observation plane that circled the detonation of the first atomic explosion, known as the Trinity Test, in south central New Mexico. The secretive nature of this test and the work surrounding it, is reflected in the fact that the only reference to the test in Fowler's notebook is the notation "TR" after the relevant dates in July of 1945.

Vugraph of Fowler notebook

A later page from Fowler's notebook was used in a Sandia photo exhibit in the fall of 1995 entitled "*End of a War . . . Beginning of a Laboratory*". It gives a picture of the variety of tasks involved as Z Division settled and expanded at Sandia Base in Albuquerque. During one week in October 1945, Fowler writes of a personal concern - to verify his income in order to qualify for housing. There are many other work-related issues noted. Fowler writes that trucks were to be brought from Trinity site to Y, the code name for Los Alamos. Later in the week, notes from a meeting of the Flight Test Group (Z-1A) mention that Sandia was assured $1,000,000 by the military in month to month installments; members of the Special Engineering Detachment would need to move soon from Los Alamos to Albuquerque in order to take classes at the University of New Mexico; and there were questions regarding Kirtland Field's policy on emergency and hospital care. This page also notes that a C-45 plane was being brought down from W-47, the code name for Wendover Field, Utah. (The Army Air Corps used Wendover as a site to drop test units during WWII.) Fowler also writes that arrangements needed to be made for deep sea disposal of 100,000 pounds of Little Boy castings left at Wendover. Lastly, Fowler mentions that Roger S. Warner replaced J. R. Zacharias as Division Z chief. These lab notes provide important historical documentation for some of the tasks necessary at the end of WWII, including the transfer of equipment and personnel to the newly established Z Division for postwar work.

Z Division grew rapidly and by 1948 was known as Sandia Laboratory, a separate branch of Los Alamos. Its increasingly important role in the production side of national defense work prompted the search for an industrial manager for the laboratory. In 1949, AT&T assumed management of Sandia Laboratory, to be operated on a no-profit, no fee basis by the Bell System's manufacturing subsidiary, Western Electric. Provision in the 1949 prime contract between the Atomic Energy Commission and Western Electric required all data prepared by Sandia Corporation in connection with the performance of work to be preserved except as otherwise directed by the Commission. The government considers inventions made by employees of government contractors are the result of federally funded research, and the patent provision of the 1949 contract indicates this. Accordingly, the Commission retained the sole power to determine whether or not a patent could be filed, as well as disposition of title rights to such inventions.

The patent provisions in the 1949 contract meant that if a Sandia employee, in the course of work, made or conceived an invention or discovery, the Atomic Energy Commission

Laboratory Notebooks

The importance of records

The quality of one's records may well determine who is entitled to the benefits of a patent in a legal conflict between your invention and another patent application or unexpired patent. Unlike countries where priority is given to who files for patent first, we use the first-to-invent standard, which suggests the importance of good records. Sandia's operating contract requires the keeping of invention disclosure files and laboratory notebooks or equivalent writings to provide legally defensible records for patent purposes.

Maximizing the value of your notebook

Notebook entries must contain the first written description and drawing of concepts that might be of patent interest. Notebook entries should tell:

- what the problem was
- when it was done
- what solution was proposed
- who did it
- what was done
- who witnessed it

To be of maximum legal value, a notebook must have bound, numbered pages. Official Sandia Laboratory Notebooks provide for proper signing, dating, and witnessing. The following guidelines should be observed:

- Entries should be made in ink for permanence and avoidance of the suspicion of alteration.
- Entries should never be backdated; a belated entry, bearing the current date, should record the actual date of an experiment or idea, as well as the names of witnesses.
- Separate charts, graphs, drawings, etc. should be fastened in the notebook with glue rather than staples or tape.
- Nothing should ever be erased;.a line through an inappropriate entry will preserve the integrity of the record. Deletions and corrections should be initialed and dated.
- Blank spaces should be marked with an "X".
- Pages should never be removed.
- If data are recorded by electronic media, the vital portions should be copied on paper and fastened in the notebook.

The return of records

Sandia Laboratory Notebooks are government property and must be returned when you leave.

If you have questions, please call the Sandia Patent organization.

Revised April 12, 1994

The Patent Contact for your organization can give you more information.

Up to patents page

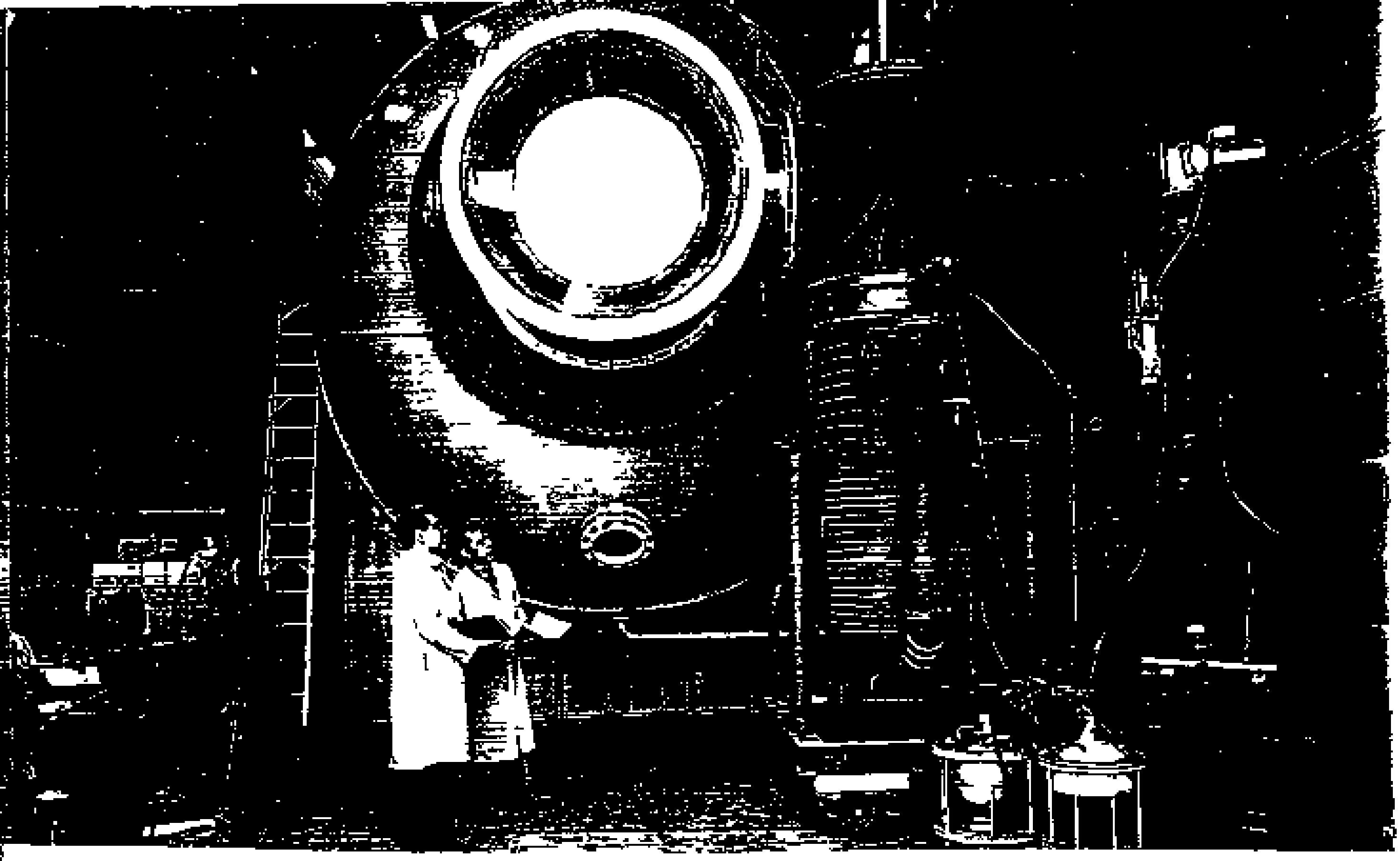
(AEC), today's DOE, was to be furnished with the complete information. The Commission would then determine whether or not a patent application should be filed. The Atomic Energy Act of 1954 excludes the patenting of inventions useful solely in the utilization of special nuclear material or atomic energy for atomic weapons, so patent opportunities were limited in Sandia's early decades. Patent applications were more likely to be filed on unclassified inventions that were determined to have commercial applications.

Vugraph on Laboratory Notebooks Use

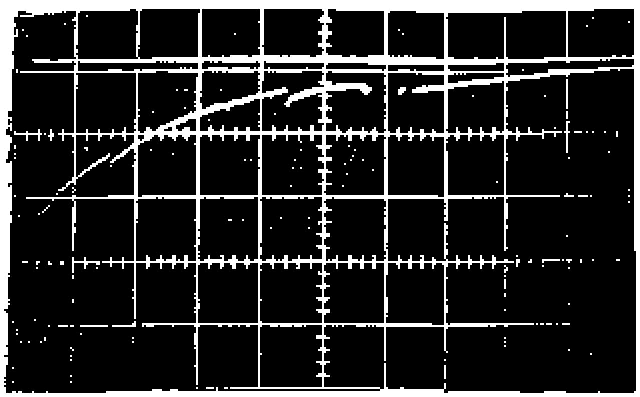
When an engineer or scientist signs in at employee orientation, they are issued a lab notebook and instructed on its use. Employees are required to sign patent agreements and, later on, if an individual wants to obtain a patent in his or her own name, he or she is required to obtain a waiver from the government.

Researchers are advised from the outset that one of the most significant records they can maintain is a Lab notebook, which details their ideas, experiments, and records data. Entries are made chronologically and may apply to many projects. Entries are to be written in ink, witnessed, signed, dated and may be used for substantiating the date of conception of a technical advance that is patentable. Entries are usually hand-written although print outs, drawings, and photographs that supplement the written information may be attached to the notebook. To be of maximum legal value, the notebook must be bound and have serially numbered pages. Unlike other countries where primacy depends on the "first-to-file" criterion, the United States uses the "first-to-invent" standard. As a result, the quality of one's records may well determine the legal outcome of an interference proceeding establishing who is entitled to a patent.

The gold in a lab notebook serves the researcher in many ways. Information in a notebook can help to avoid duplicate efforts and can be a substantive aid to the researcher in developing a solution to a technical problem. Notebooks serve as a source of information for later reports and technical talks. They are a valuable record for patent



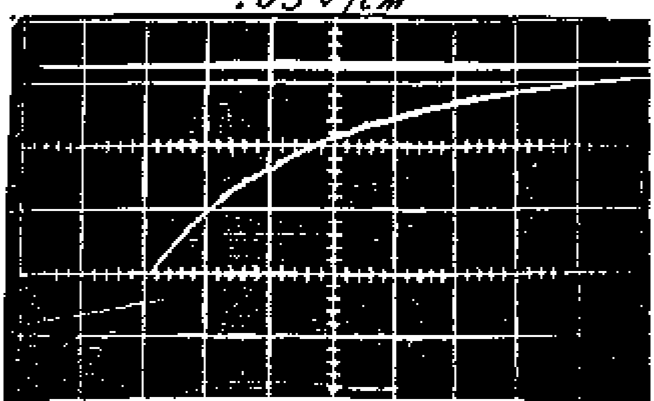
52



2.6 cm x (.05) x 107[illegible] =
1,3949 KV

Shot #1 - 1 KV Charge
20 msec/cm
.05 V/Cm

Ball Discharge



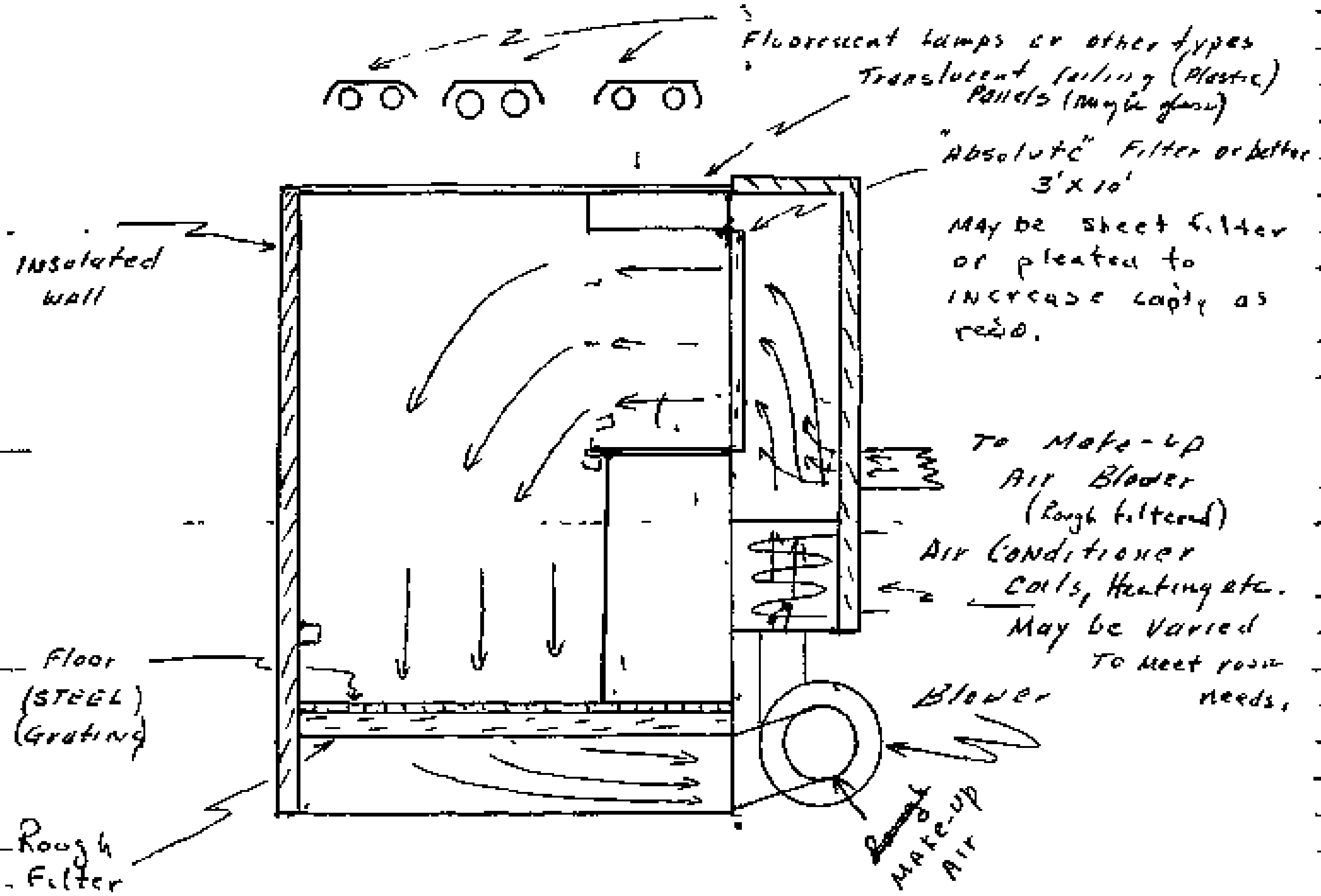
Shot #2 - 5 KV Charge
20 msec/cm

purposes and relate what work was done, when, by whom, and who knew about it. Once information has been entered into a notebook, questions can be answered years later, long after the researcher's memory may have faded.

Vugraph of data from and photo of HERMES II

The documentation included in a lab notebook is a valuable component of the project file, providing continuity to the program when other details are not available. Most of the information recorded in notebooks is not used for patent purposes but provides essential documentation to the researcher. For example, this notebook page shows test data and a photo of HERMES II, a flash x-ray machine built in 1968 to subject materials and components to radiation testing. No patent applications were filed for this one-of-a-kind machine, however, this page illustrates the valuable test data recorded. HERMES II was retired in 1990 after 30,000 tests. Data recorded in laboratory notebooks like this one reflect its capabilities and document the evolution of Sandia's work in radiation testing. Some lab notebooks contain information that substantiates invention disclosures submitted to Sandia's patent office. Sandia patent attorneys or agents review the disclosure and, if the invention is determined to have commercial potential, apply for a waiver of title from DOE and proceed with the patenting process. Other disclosures are sent on to the DOE for review and possible patenting. Prior to 1989 and the National Competitiveness Technology Transfer Act, all Sandia Laboratories patents became public property and no royalties were received. The DOE granted a non-exclusive license to the benefit of any individual or manufacturer who made proper application. When an invention is classified, the prospective patent is held in abeyance. The security classification is reviewed yearly and the idea is still protected by patent laws. If the day arrives when the invention is no longer classified, the patent is examined for possible granting. It usually takes about two years from the date of application to awarding of any patent; in 1995, 90 patent applications were filed for Sandia inventions, and 33 patents were issued.

Cross section of Clean room



INTERIOR - 6'W x 10'L x 7'H

Doors and windows are not shown, since they may be the same as used in present Clean room design. No entry air lock is provided or air shower. No need is anticipated except when exterior opening is involved, then an air lock is recommended.

Vugraph of drawing from Willis Whitfield's laboratory notebook

The gold in lab notebooks sometimes results in a patent if the invention is novel and unobvious. No discussion of Sandia's patented inventions would be complete without mention of the Laminar Flow Clean Room invented by Willis Whitfield in 1960 and patented in 1964. Whitfield's work began when he was asked to investigate the inadequacy of clean rooms to maintain cleanliness levels for manufacturing of electromechanical components. The clean rooms at that time were little more than air-conditioned rooms with a janitorial staff constantly cleaning surfaces inside the room. After Whitfield toured many of these early clean rooms, he discovered the problem was that air-flow patterns in conventional clean rooms were not uniform and could not remove airborne contamination from the room as quickly as it was introduced. He said, "It was like taking a bath in dirty water."

Photo of clean room and Willis Whitfield

He determined that single-pass, unidirectional air flow, called laminar flow, would resolve the problem. So Whitfield designed a clean room that was, "like bathing in a moving stream." He had an 8-by-10-foot clean room constructed in late 1961. It contained a single work bench, high-efficiency particulate air filters formed the wall from floor to ceiling behind the work bench, and the floor was 100% grating. As air flowed through the room and out through a grating in the floor, it removed contaminating particles. This amazingly simple idea resulted in an environment more than 100 times cleaner than conventional clean rooms and 40 to 60% cheaper to maintain. Whitfield's design proved so efficient that a large down flow clean room was soon built by Sandia and, in April of 1962, Willis presented his first formal paper on his clean room work to a national meeting. The response to this technological breakthrough was tremendous. Laminar flow clean rooms have been adopted by hospitals, food and pharmaceutical manufacturers, and are used in virtually every microelectronics and semi-conductor manufacturing facility in the world. This invention led to a federal standard on clean from 500 to 600°C The new battery operates

graduate from UNM with a BS in EE in May

BATTERY invented by Ron
Don Nissen (both 1913) was
by the AEC. The device uses an
oes not melt during the output

LAB NEWS

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SANDIA LABORATORIES • ALBUQUERQUE NEW MEXICO • LIVERMORE CALIFORNIA • TONOPAH NEVADA

ir Blast
s Better

hat levels solder on printed CBs) with a blast of heated with hot liquid has been Allen and Bob Sylvester of cess Development Division

hine leaves a thicker layer of ards, produces boards faster epeated thermal shocks, solder from through-holes does not emit objectionable

ically covered with flux and or hot liquid to provide a coating for the thin copper to provide a metallic layer to nts, such as transistors, can soldered.

is process leaves an uneven the board, and excess solder rough-holes, which connect a board.

he solder has been leveled — emoved — by inserting the hine which sprays the board ion of polyglycol. Repeated cessary to produce a uniform r the holes.

s — at least 12 are required l subject the PCB to repeated In addition, the spray does ove excess solder from the not leave a layer of solder at least .0003-inch) to meet ations for PCBs.

uid solder levelers do not p implementation of the etched pattern-fused solder arate solder pot is required to process, which is being d because of its lower cost.

ot gas leveler solves these icing completed PCBs of any le pass between a pair of air sitioned above the solder pot. bout .20-inch wide, 7 inches

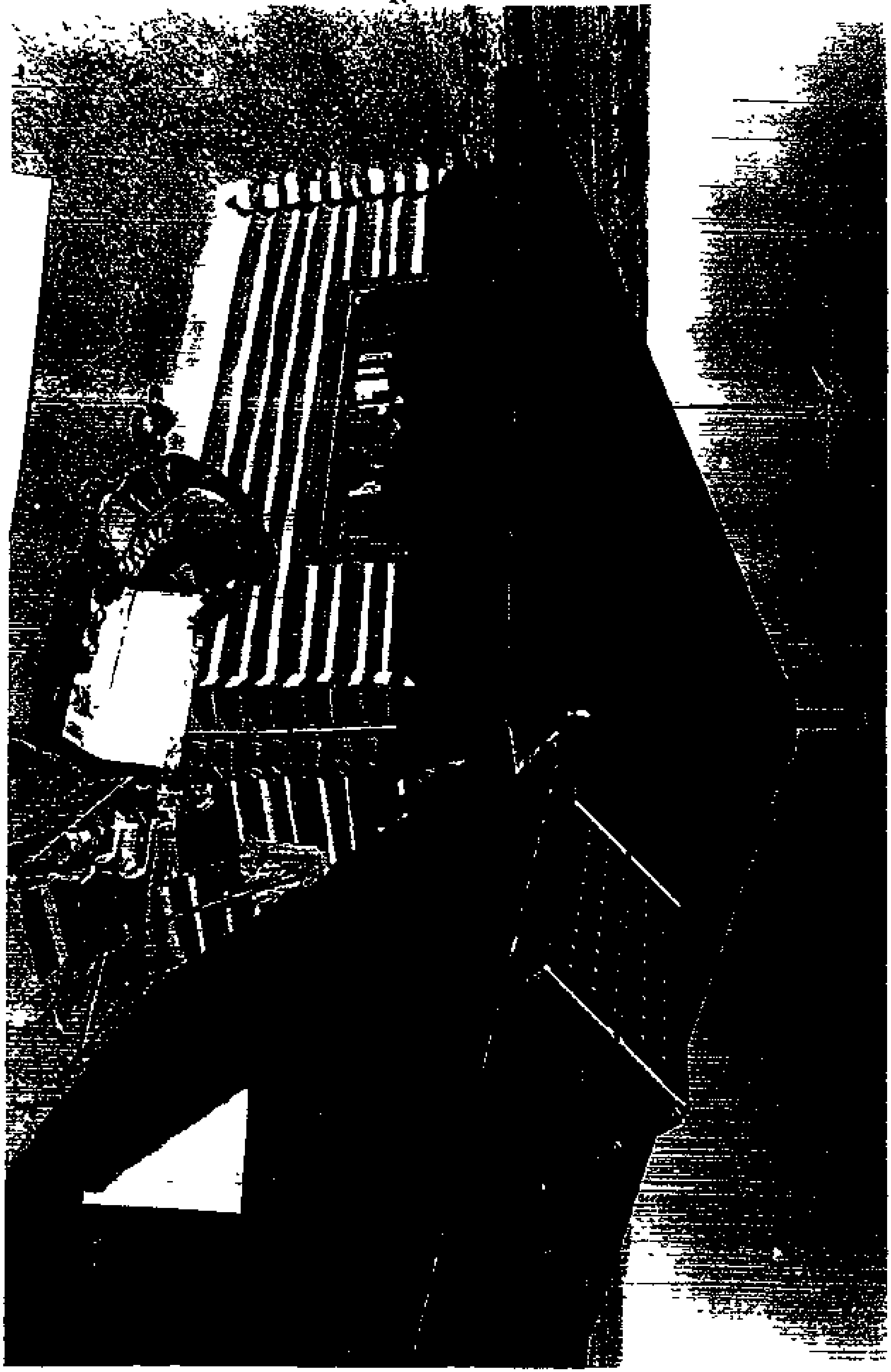
inued on Page Four)

BOB SYLVESTER AND T A. ALLEN (both 7123) examine printed circuit board emerging from machine they've developed that levels solder on PCB with blast of hot air room environments. Whitfield was educated as a physicist. However, in 1969 he received the highest engineering award, the Holley medal, which is bestowed on "one who by some great and unique act of genius of an engineering nature has accomplished a great and timely benefit". He joined the ranks of few other medal winners, including Henry Ford, William Shockley - inventor of the transistor and Edwin Land - inventor of the Polaroid camera.

Vugraph of Bob Sylvester and T. A. Allen article on patent for PCB Machine

Another bit of gold is the hot-air solder leveler invention. In the late 60s, as part of Sandia's work on the VELA satellite detection system, printed circuit boards were produced with liquid solder, a time consuming and unreliable method. According to inventors T. A. Allen (a metallurgist) and Bob Sylvester (a chemist), their invention process was "born of necessity", simply because they wanted to manufacture circuit boards without tying up all of their work space. In 1975, a patent was issued for a hot-air solder leveler that pushed flux across circuit boards with hot air to prevent oxidation of the solder. This invention reduced processing time by 70% and drastically reduced chemical use and pollution. Applied by the circuit board industry, hot-air leveling became a billion dollar a year business, allowing for the efficient manufacture of printed circuit boards used in communication equipment, such as television, radio receivers, computers, and even hearing aids.

Sandia's capabilities broadened in the 1970s and '80s to include energy and environmental programs and work for other government agencies. This broadened mission allowed additional opportunities for commercial application of Sandia-developed technology. Although patents were released to the public, there was not a formal process in place for Sandia to work with private industry to collaborate to further technology. This changed in 1989 with the passage of the National Competitiveness Technology Transfer Act. This significant event allowed technology transfer to gain full status as a DOE mission, permitting DOE contractor-operated laboratories to sign Cooperative



SPECIALTY METALS PROCESSING CONSORTIUM PIONEERED COLLABORATION BETWEEN LABS AND PRIVATE INDUSTRY

SANDIA'S CONTRIBUTIONS TO SMPC, FOUNDED OVER THREE YEARS AGO, HELP STRENGTHEN ECONOMIC COMPETITIVENESS IN THE VITAL DOMESTIC SPECIALTY METALS INDUSTRY

"Member companies of the Specialty Metals Processing Consortium are pooling research dollars to work on generic process problems directly applicable to the industry. Specialty metals is a vital industry where the United States maintains a competitive edge. Through collaboration of the government labs, industry, and universities, it is likely that we can keep, or possibly even increase, this edge."

—Robert Torcolini, SMPC Founding President, July 1990

Now Sandia's unique liquid-metal processing expertise and equipment—used for years for defense components—is making this SMPC goal a reality.

▲ SMPC industrial intern Mike Grose (left) of INCO Alloys International runs a test on a window rotation device on Sandia's vacuum-arc-remelt research furnace, while Sandian Rod Williamson makes adjustments on a monochromatic imaging spectrometer. Mike was the first industrial intern to come to Sandia as a result of Sandia's involvement in the Specialty Metals Processing Consortium. This internship program is one example of how Sandia has transferred generic, precompetitive know-how to SMPC member companies.

Jet turbine blades, chemical reaction vessels, defense hardware, and a host of other components must hold up under extraordinary mechanical stress, heat, and corrosion. The specialty metals industry makes innovative materials for these demanding applications.

For years, the U.S. has globally dominated the specialty metals industry. By the late 1980s, however, domestic specialty metals producers were becoming more vulnerable to foreign competition. Although the United States continued leading the world in specialty metals production, American companies were cutting research funds and eliminating research and development (R&D) labs. Meanwhile, Pacific Rim countries and Europe continued making heavy investments in specialty metals R&D to enter U.S. markets.

For example, by 1989 Japan had just installed 12 new electron-beam furnaces, for a total capacity of 5,530 kilowatts. Though this equaled only about half the

Continued on back

WHO BELONGS TO SMPC?

Contributing to the cohesiveness of the Specialty Metals Processing Consortium is the full spectrum of the specialty metals industry represented by its members—from material suppliers to hardware manufacturers, to end users. The breadth of industry represented provides the perspective necessary to ensure that the generic research meets industry-wide needs.

SMPC is composed of the following member companies: Allegheny Ludlum

Continued on back

Research and Development Agreements, called CRADAs, with private industry. After 1989, the Laboratories could negotiate directly with industry, share intellectual property developed in a CRADA, and withhold publication of commercially valuable information for up to five years. In this way, Sandia and one or more partners outside the federal government (usually from industry or academia) collaborated, shared costs, and shared golden opportunities from promising new research and development projects.

Since then, Sandia has participated in hundreds of joint projects with U. S. industry, and currently, there are approximately 120 CRADAs in place. In addition to CRADAs, Sandia's technology transfer program employs personnel exchange, user facilities, cost-shared contracts, technical assistance, and information distribution to further the transfer of technology. The program also includes the patent and licensing functions. One objective in Sandia's licensing function is the recouping of a portion of the taxpayer investment in Sandia technology through the receipt of royalties from licensing patented and copyrighted intellectual property. 70% of the royalty is distributed to Sandia originating departments to fund other research and development projects. The remainder is shared by inventors and others who substantially increased the technical value of the invention and a small amount is reserved for developers of classified non-commercial technologies in use.

Vugraph of Hogan

As a outgrowth of solar energy work initiated in the 1970s, Sandia developed expertise in providing power via solar concentrators and receivers. This expertise was utilized in one tech transfer project sponsored by the DOE and the NM Department of Minerals and Natural Resources. A photovoltaic array provided lighting and access to television for homes in remote areas of the Navajo reservation in New Mexico.

Vugraph of Specialty Metals work

Sandia and other national laboratories also participate in several consortiums to help industry become more competitive in the global marketplace. One example is *The*

This page removed.

Specialty Metals Processing Consortium, founded in 1990 to pool research dollars of the government labs, industry, and universities to work on processing problems associated with specialty metals. By 1994, two patent applications pertaining to melting control strategies had been filed. Patents resulting from collaborative research are held by Sandia and made available to consortium members through a royalty-free licensing arrangement. Sandia facilities originally built for making specialized metals for weapon components are now available to consortium members. Technology transfer initiatives have allowed the "gold", demonstrated by the national labs innovations, and documented in lab notebooks, to be utilized in collaboration with private industry for promising new research and development projects.

The lab notebook represents Sandia's expertise and for a long time, notebooks were determined to have permanent disposition. In an updated schedule, awaiting DOE and NARA approval, lab notebooks'retention periods now extend from six months to 75 years, depending on content. Currently, there are approximately 20,000 unclassified and classified notebooks in storage. It is important to mention that some notebooks are not useful because they are illegible or blank. Those notebooks will eventually be destroyed .

Vugraph of Patent Office database

Throughout Sandia's history, its Patent office has been responsible for issuing and managing lab notebooks. When an employee retired, most notebooks were returned to the Patent office, although some were retained in the department. The Patent Office has a database that tracks lab notebooks. As a result of developing the new retention schedules, records managers, in conjunction with inventoried departments, have determined that notebooks would be more accessible by retaining them with the original project records, adopting project record retention schedules. The Patent Office is working with records management to modify Sandia's policy and identify notebooks from the Patent Office database to place them with appropriate project files. In addition, Corporate Archives is working closely with the Patent office to ensure that lab notebooks are appraised for historical significance.

I have discussed how laboratory notebooks were used at Sandia National Laboratories from the beginning as staff was deployed from the Manhattan Project in Los Alamos to Z Division, which later became Sandia and record Sandia's early history. In the prime contract of 1949 between the AEC and Bell System's manufacturing subsidiary, Western Electric, Sandia employees were directed to preserve the record of their work in lab notebooks and to assign patent rights to the government. Sandia's Patent and Licensing Office directed the scientists and engineers on the importance and use of lab notebooks. Lab notebooks record unique test data and important information even when not used for a patent. From the beginning, Sandia shared the gold in the laboratory notebooks; this resulted in the transfer of technology from inventions such as the clean room and improved fabrication of printed circuit boards. Before 1989 all patented inventions became public property. After 1989 and the passage of the National Competitiveness Technology Transfer Act, Sandia entered into CRADAs with private industry. Technology transfer gave private industry the golden opportunity to utilize the technology and expertise of the national laboratories.

Laboratory notebooks, pending approval of the proposed retention schedule, will have the same retention as their associated project files. However, Sandia Archives is working with the Patent Office to insure that notebooks will be appraised for historical value before final disposition. We are working to update Sandia policy and to place laboratory notebooks with relevant project files to promote greater usefulness of the material.

Finally, I hope I've shown you that "Thar's truly gold in Sandia's laboratory notebooks" - as a record of Sandia's history, as validation of new inventions, and as a reflection of the expertise developed and fostered in a national laboratory to benefit the public.