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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER N00014-83-C-0744	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) LASER R & D IN THE ARMED SERVICES		5. TYPE OF REPORT & PERIOD COVERED Annual Summary Report 9-15-83 through 9-15-84
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Dr. Robert W. Seidel, Independent Dr. Joan Lisa Bromberg, Laser Institute of America		8. CONTRACT OR GRANT NUMBER(s) N00014-83-C-0744
9. PERFORMING ORGANIZATION NAME AND ADDRESS Laser Institute of America 5151 Monroe St. Suite 118 W Toledo, OH 43623		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS 61153N, NR395-803, RR 011-07-01
11. CONTROLLING OFFICE NAME AND ADDRESS Procuring Contracting Officer Office of Naval Research /800 N. Quincy Street Department of the Navy /Arlington, VA 22217		12. REPORT DATE 9-15-84
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) Defense Contract Administration Services Management Area, Detroit - McNamara Federal Bldg., 477 Michigan Ave. Detroit, MI 48226		13. NUMBER OF PAGES 7
1. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited		15. SECURITY CLASS. (of this report) UNCLASSIFIED
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE NA
18. SUPPLEMENTARY NOTES		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) INTRODUCTION DOD DATA BASES RESEARCH TRAVEL TECHNICAL REPORTS INTERVIEWS RESEARCH TRAVEL INTERVIEWS RESULTS		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) During the year, September 15, 1983 - September 15, 1984, Dr. Joan Lisa Bromberg has investigated the history of the laser through the interviewing of laser industry pioneers and leaders in California's Bay area and the Murray Hill branch of AT & T's Bell Labs. The status of processing of the interviewee's tapes is listed. During the course of the first year of our project, Dr. Robert W. Seidel has investigated the history of military laser research and development through		

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the exploitation of

1. the Department of Defense's Research and Development data bases, including the Research and Development Plans, Work Unit Information Summaries, and the Technical Report Abstracts of the Defense Technical Information Center;
2. published and unpublished technical reports of military laser research and development available through DTIC and at military installations;
3. visits to military installations and research facilities holding manuscript materials relating to history of laser research and development;
4. formal and informal interviews with participants in military laser R&D projects.

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INTRODUCTION

In September, 1983, the Department of Defense granted the Laser Institute of America \$75,000, of which \$9,450 was earmarked for oral history, and \$53,685 for the history of military laser research and development. An additional \$12,075 was to be devoted to two videotaped interviews. (All figures include 5% LIA overhead.) Because of the richness of materials that has been uncovered on military R&D, and the importance of the interviewing results, the Laser Institute of America has recently requested permission to divert the money assigned for videotaping into more work on military R&D and oral history. This report covers LIA activities in these latter two areas.

ORAL HISTORY

So much of modern science is conducted by telephone or in conference or committee rooms, that historians can no longer confine themselves to the study of published works, unpublished documents, and artifacts. Oral history has become an essential tool in the reconstruction of the development of modern science and technology, and from the first, the Laser History Project has made it an important part of its work.

The DoD contract money allocated to this area was used to fund nine interviews with scientists, engineers, and laser industry leaders in California's Bay Area, and four interviews with scientists and science administrators at the Murray Hill branch of AT&T's Bell Laboratories.

Each interview trip was preceded by a period of preparation during which the interviewer, Laser History Project director, Dr. Joan Lisa Bromberg, read through the scientific publications of the persons to be interviewed and prepared detailed sets of questions. The questions were sometimes forwarded in advance, and sometimes presented at the interviews.

The trip to California was made in January 1984. Bromberg went first to Spectra-Physics of San Jose and Mountain View; this firm was one of the earliest in the laser field, and is one of the most successful of the commercial companies. At Spectra-Physics, she interviewed the company president, Herbert M. Dwight, the first president, Robert Rempel, Kenneth Ruddock (with Rempel, Dwight, W.E. Bell and Arnold Bloom, one of the five founders), and leading scientist John Goldsborough.

Her next interview was with James Hobart, one of the founders of Coherent, Inc., which was a spin-off from Spectra-Physics in the mid 1960s. At Stanford University in Palo Alto, Bromberg interviewed Nobel Laureate Arthur L. Schawlow, coauthor with C.H. Townes of the 1958 paper, "Infra-red and Optical Masers," which was a major stimulus to the invention of the laser. She also interviewed T. W. Hänsch, whose innovative methods have helped revolutionize the application of lasers to spectroscopy, and

laser engineer, Professor A.E. Siegman. From Stanford, Dr. Bromberg traveled to Berkeley where she collaborated with Research Historian Dr. Seidel in an interview with Prof. Townes, whose 1964 Nobel Prize recognized his invention of the maser as well as his pioneering contribution to the laser. She also held informal interviews with Erwin Hahn and George Pimentel, as preludes to future, taped interviews. (The interview with Prof. Pimentel was carried out in May 1984).

The trip to Bell Laboratories spanned the last days of May and the first days of June, 1984. Dr. Bromberg interviewed C.K.N. Patel, inventor of the carbon-dioxide laser and the spin-flip Raman laser, Eugene I. Gordon, who, in addition to his scientific contributions, played an important role in the founding of the Journal of Quantum Electronics and the Conference on Lasers and Engineering Applications (CLEA), Sidney Millman, who as Director of the Research Division in the 1950s and early 1960s was in a position to give an administrator's perspective on early laser research at Bell, and Joseph A. Giordmaine, who helped design and build the first maser telescope, and subsequently carried out important researches in nonlinear optics.

Stanford University Archives undertook to transcribe the tapes of Schawlow, Hänsch, and Siegman. Bell Laboratories Archives volunteered to take responsibility for the tapes of Patel, Millman, and Giordmaine. It was decided that the tapes by Rempel, Ruccock, and Goldsborough be added to the Laser History Project without transcription. The American Institute of Physics' Center for History of Physics, which has been transcribing the bulk of the Project tapes, took responsibility for the rest of the transcription.

In line with usual Laser History Project procedures, Dr. Bromberg is editing all transcripts, and providing them with tables of contents and abstracts, and the Center for History of Physics is retyping them and assembling them in final form for the use of scholars.

The following table recapitulates the interviewees, and shows the status of processing of transcripts.

<u>Interviewee</u>	<u>Length of tape</u>	<u>Status of Transcript</u>
H.M. Dwight	1 hour	transcribed & edited
J. Giordmaine	3 hours	being transcribed
J. Goldsborough	3/4 hour	retained without transcription
E.I. Gordon	2 1/4 hr.	being transcribed
T.W. Hänsch	1	being transcribed
J. Hobart	1 1/4	being transcribed
E. Hahn	informal interview	
S. Millman	3/4	being transcribed
C.K.N. Patel	6	being transcribed
G. Pimentel	(1 1/2 subsequent int.)	being transcribed
R. Rempel	3/4 hr.	retained without transcription
K. Ruddock	3/4 hr	retained without transcription
A.L. Schawlow	2	transcribed & edited
C.H. Townes	4	being transcribed
A.E. Siegman	1 (another session planned)	being transcribed

THE HISTORY OF MILITARY LASER RESEARCH AND DEVELOPMENT

During the course of the first year of our project, Dr. Robert W. Seidel has investigated the history of military laser research and development through the exploitation of

1. the Department of Defense's Research and Development data bases, including the Research and Development Plans, Work Unit Information Summaries, and Technical Report Abstracts of the Defense Technical Information Center.
2. published and unpublished technical reports of military laser research and development available through DTIC and at military installations.
3. visits to military installations and research facilities holding manuscript materials relating to the history of laser research and development.
4. formal and informal interviews with participants in military laser R&D projects.

These activities are detailed below.

DOD DATA BASES

Immediately after the commencement of the project, the Research Historian, Robert W. Seidel, conducted a literature search using the facilities of the University of California libraries and those of the Lawrence Berkeley Laboratory. Through this search, he became aware of the large numbers of series of technical reports and other literature available in the Department of Defense. A preliminary request for a bibliography of technical reports relating to the history of military laser research and development was submitted through the Lawrence Berkeley Laboratory in October, 1983. The bibliography which resulted from this request was confined to the period 1973-1978 and, because of the search strategy used, contained only a fraction--several hundred--of the reports of interest. As a result of the cooperation of Mrs. Margot O'Drobinak of the Technical Library at the Naval Weapons Center in China Lake, California, Dr. Seidel had a more thorough search made in February, 1984.

This search, conducted of the Technical Report Data base, identified 11,573 reports under 112 separate laser search terms, representing the available products of 24 years of research in lasers. These reports, and the abstracts thereof obtained from the Defense Technical Information Center have been used to formulate interview questionnaires, to identify significant research accomplishments by DOD laboratories and contractors, and to reconstruct research programs and their intersections with other research programs in the Department of Defense.

A search was also conducted of the Work Unit Information Summary Data Base which produced 5158 summaries. Each represents one stage in the development of a particular research program, and, by analyzing these forms, it is possible to relate contractor and in-house research to particular research programs, iden-

tify those breakthroughs and accomplishments which are not recorded in technical reports or other publications, and to find unproductive research efforts. Used in conjunction with the other elements of the DTIC data bases in a historical fashion, it is possible to identify contractor research projects which were funded from several research programs.

At the same time a search was made of the Research and Development Planning Summaries (DD Forms 1634) which identify projects conducted and/or monitored by military laboratories. These summaries correspond to specific research programs in laser research and development. With their help, it is possible to relate contractor activity to in-house research, to determine how the resources are distributed between projects constituting a specific research program, and to identify the individual(s) responsible for a given research program for possible interview. Approximately 1425 such reports were received from DTIC.

Subsequently, having established DTIC User status for himself, Dr. Seidel ordered more specialized bibliographies and compilations of Work Unite Information Summaries and Research and Development Planning Summaries. An attempt is being made to establish on-line access to the DTIC data bases through the Office of Naval Research in order to be able to interactively search this data base.

TECHNICAL REPORTS

Because of a delay occasioned by the mishandling of his request for a security clearance, Dr. Seidel was not immediately able to consult classified technical reports. Through the assistance of Dr. Arthur Guenther, Chief Scientist at the Air Force Weapons Laboratory, access was obtained to the Technical Library there in December, 1983. Using his Q clearance through the Department of Energy, Seidel was able to consult many technical reports at AFWL during visits to the Air Force Weapons Laboratory in December 1983 and February 1984. Subsequently, with the assistance of Dr. William Krupke of the Lawrence Livermore National Laboratory, the staff of the historian's office of the Department of Energy, and Mr. Thayne Nielsen of the Department of Energy San Francisco Area Office, Dr. Seidel was able to obtain access to the Lawrence Livermore National Laboratory technical library, which houses many technical reports of interest. In addition to these libraries, during his research trips, Dr. Seidel has made use of the Technical Libraries at the Naval Weapons Center in China Lake, California, the Naval Research Laboratory in Washington, D. C. and at Redstone Arsenal in Huntsville, Alabama. Several hundred technical reports have been consulted in the course of the project.

RESEARCH TRAVEL

In order to consult manuscript and other documentary resources, to interview living participants, and to consult with service historians and make use of their facilities, Dr. Seidel has travelled to a number of centers of military laser research and development. Approximately thirteen weeks of the first year

were spent in travel for the Laser History Project.

Facilities visited and the dates of visits are listed in the following table:

FACILITY	DATES OF VISIT
Air Force Weapons Laboratory, Kirtland AFB	3-16 December 1983
	6-17 February 1984
	9-13 July 1984
Naval Weapons Center, China Lake, CA.	15-19 January 1984
Office of Naval Research, Washington, D.C.	9-27 April 1984
The Pentagon, Washington, D.C.	18-21 April 1984
Naval Research Laboratory, Washington, D.C.	9-27 April 1984
Air Force Office of Scientific Research Washington, D.C.	26 April 1984
Defense Advanced Research Projects Agency, Washington, D.C.	16-26 April 1984
David W. Taylor Naval Ship R&D Center, Bethesda, MD	23 April 1984
Institute for Defense Analyses, Alexandria, VA	23-27 April 1984
Lawrence Livermore National Laboratory, Livermore, CA	Repeatedly from 29 March 1984
Mathematical Sciences Northwest, Inc.	21 May 1984
Redstone Arsenal, Huntsville, AL	4-15 June 1984
Air Force Historical Research Center, Maxwell AFB, AL	18-21 June 1984
Los Alamos Scientific Laboratory	17-18 July 1984

INTERVIEWS

During the course of the project, Dr. Seidel has interviewed a number of individuals, both for archival and for background purposes. The following Table shows the subjects, affiliations and hours (for taped interviews):

TABLE II. INTERVIEWS

SUBJECT	AFFILIATION	HOURS
Dr. Thomas Barr*	University of Alabama, Huntsville	2**
Mr. Norman L. Bell*	HELLFIRE Project Office, Redstone Arsenal	4
Dr. Harold Bennett	Naval Weapons Center, China Lake	
Dr. William Bridges	California Institute of Technology	
Dr. William Condell	Office of Naval Research	
Dr. Robert S. Cooper*	Defense Advanced Research Projects	2.5

	Agency	
Dr. Louis Drummeter	Naval Research Laboratory	
Dr. Anthony Duncan*	Directed Energy Directorate, Redstone Arsenal	2
Dr. Edward T. Gerry*	W.J. Schafer Associates, Inc.	2***
Dr. Arthur Guenther*	Air Force Weapons Laboratory	1.5
LTC Ronald Grotbeck*	Air Force Weapons Laboratory	3
Dr. Abraham Hertzberg*	Mathematical Sciences Northwest	4
Mr. Thomas Honeycutt*	Directed Energy Directorate, Redstone Arsenal	2**
Dr. Theodore Jacobs	Office of the Assistant Secretary of the Navy for Research and Development	
Mr. W. B. Jennings*	Directed Energy Directorate, Redstone Arsenal	4
Dr. William Krupke	Lawrence Livermore National Laboratory Laser Division	
Mr. Demos Kyrakis	Air Force Weapons Laboratory	
MG Donald L. Lamberson*	Deputy Chief of Staff, U.S. Air Force	2.5
Dr. Donald Levine	JASON Division, MITRE Corporation	
Dr. W. B. McKnight*	Directed Energy Directorate, Redstone Arsenal	2**
Dr. William Otto*	Directed Energy Directorate, Redstone Arsenal	3**
Mr. H. Lee Pratt*	MICOM Ground Laser Locator Designator Project Office	2**
Mr. Gerald Scheiman	Directed Energy Directorate, Redstone Arsenal	2**
Mr. Nick Schneider	Naval Weapons Center, China Lake	
Dr. Walt Sooy*	Lawrence Livermore National Laboratory Laser Division	4
Dr. Steven Seitel	Lauritsen Laboratory, Naval Weapons Center	
Dr. Jacob Speidel	Air Force Weapons Laboratory	
Dr. Charles Townes*	University of California, Berkeley	1
Dr. Eugene Wiedenhofer*	MICOM Ground Laser Locator Designator Project Office	2**

*Tape-recorded interviews

**Joint interviews

***Interview in progress

As a result of this research, Dr. Seidel has acquired a sizable collection of data relating to the history of military laser research and development. It has become clear that the dimensions of that history are much larger than we previously imagined. Further interviews and research are planned to provide an overview of the entirety of the Defense Department effort sufficient to prepare an historical essay on the topic, to provide oral histories and a finding aid to identify resources for use by future historians and other students of the history of military laser research and development.

RESULTS

The results of Dr. Seidel's research will take the form of interviews, in the form of tape-recordings and transcripts, a finding aid to documentary resources, and a manuscript suitable for declassification. These items are subject to review by ONR for security and proprietary purposes. They are currently in preparation.

STATUS REPORT-CONTRACT N00014-83-C-0744

LASER R & D IN THE ARMED SERVICES

1. NO graduate students or postdoctoral personnel are associated with the contract.
2. NO graduate students have earned advanced degrees on the contract.
3. Principal investigator, Robert W. Seidel, is not associated with any other government sponsored research.
4. Current (October 9, 1984) status of contract funds \$53,087.50
Funds expected to remain in contract at end of
contract period(September 14, 1985) 0.00
5. NO permanent equipment has been purchased during contract period.