

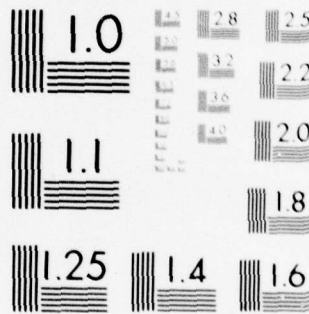
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SUMMARIES OF RESEARCH
FISCAL YEAR 1979

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Bethesda, Maryland

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NAVAL DENTAL RESEARCH INSTITUTE
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SUMMARIES OF RESEARCH
Fiscal Year 1979

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These summaries cover research carried out from 01 October 1978 through
30 September 1979.

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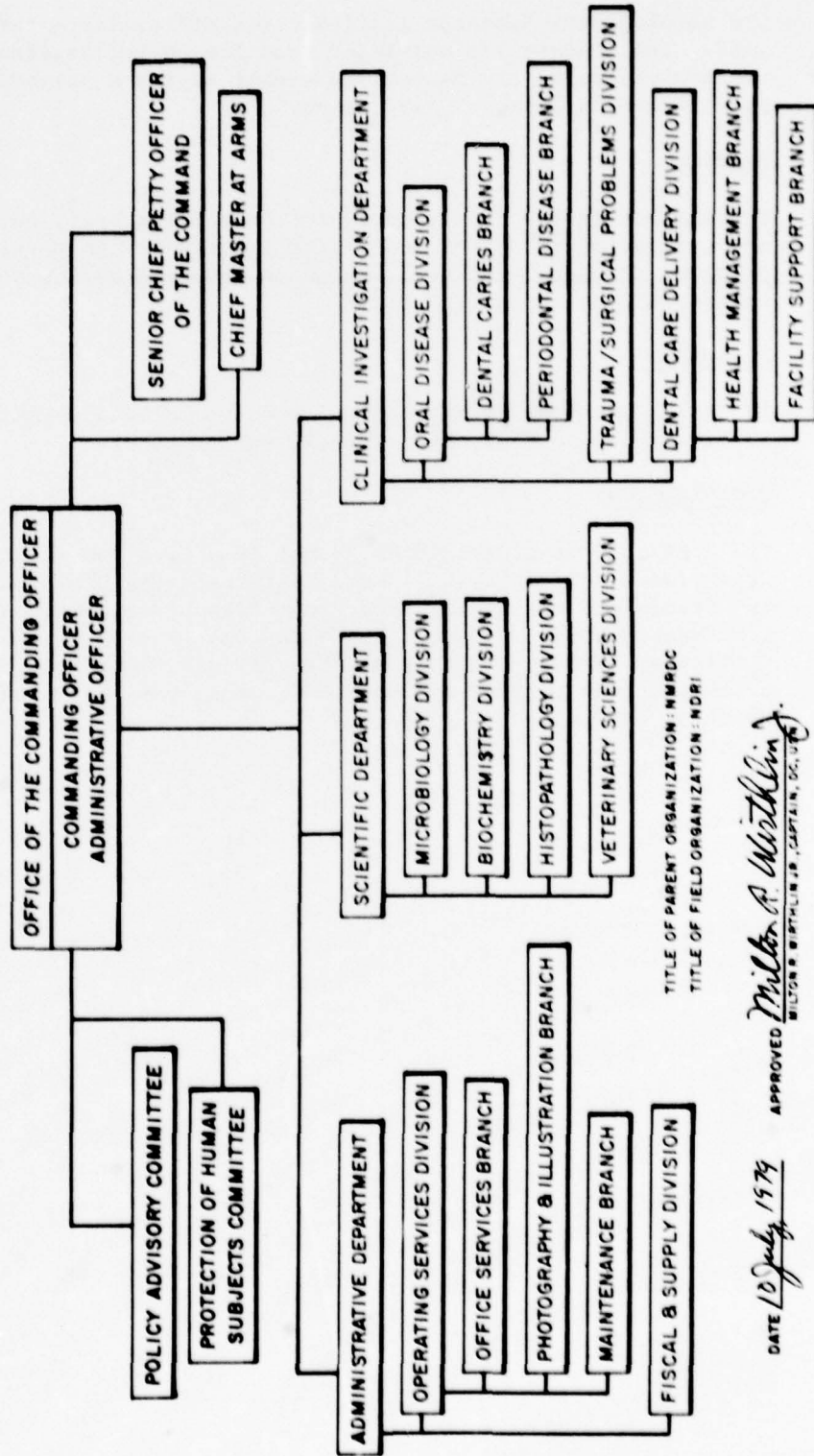
M R Wirthlin Jr.
M. R. WIRTHLIN, JR.
Captain, DC, USN
Commanding Officer

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NOTE 1. Comptroller and Military Personnel Record support performed by Naval Regional Medical Center, Great Lakes. Civilian Personnel Record Support performed by CCPO, Great Lakes.

NAVAL DENTAL RESEARCH INSTITUTE



TITLE OF PARENT ORGANIZATION: NMRDC
TITLE OF FIELD ORGANIZATION: NDRI

DATE: 10 July 1979
APPROVED: *Milton A. Wirthlin*
MILTON A. WIRTHLIN JR., CAPTAIN, DC, USN

MISSION

COMMAND

The Naval Dental Research Institute was officially established 01 January 1967. The command was developed from the Dental Research Facility, which was a Division of the Dental Department of the Naval Administrative Command, Naval Training Center, Great Lakes.

MISSION

The mission of the Institute is to conduct research, development, test and evaluation in dental and allied sciences, with particular emphasis on problems of dental and oral health in Navy and Marine Corps populations ashore, afloat and in the field.

PERSONNEL

As of 30 September 1979, there were on board 14 commissioned officers, 13 civilian personnel, and 17 enlisted personnel.

ORGANIZATION

The Institute re-organized 05 August 1976 from two (2) to three (3) Departments. Recently the Dental Care Delivery Division was divided into two Branches. The Health Management Branch deals with epidemiology, treatment needs, and community demonstration type of clinical trials. The Facilities Support Branch evaluates devices, materials, and equipment systems unique to Navy and Marine Corps operations. See organization chart on the preceding page.

FORMAL PRESENTATIONS OF RESEARCH MADE AT MEETINGS OF SCIENTIFIC SOCIETIES
RESULTS REPORTED AND/OR DISCUSSIONS LED

OCTOBER

SHKLAIR, I. L. presented "A Nutritional Survey of Caries-Free Naval Recruits" at a conference on Foods, Nutrition and Dental Health at the American Dental Association.

JANUARY

HANCOCK, E. B. presented "Review of Graduate Research Projects," Graduate Periodontics, Indiana University, School of Dentistry, Indianapolis, Indiana.

SHKLAIR, I. L. presented a talk on "Current Research on Dental Caries and its Control" at the South Suburban Dental Society.

FEBRUARY

HANCOCK, E. B. presented "Evaluation of Treatment of Periodontally Involved Root Surfaces Using Cell Culture" at the Chicago Section American Association for Dental Research meeting.

MARCH

WIRTHLIN, M. R. presented "Research and Its Application to the Navy/ Marine Recruit" to the Dental Officer's Conference for Recruit Training Center, and Second Annual Senior Dental Officers of certain major Marine Corps Commands Conference.

The 57th General Session of the International Association for Dental Research meeting held in New Orleans, Louisiana was attended by the following staff personnel:

CLARK, G. E. presented "Purification of Permeability Factor from Carious Dentin Extracts."

GALICH, J. W. presented "Evaluation of Methods for Detection of Incipient Carious Lesions."

GAUGLER, R. W. presented "S. mutans Glucan Production and Proximal Caries Activity in Rats."

HANCOCK, E. B. presented "Histologic Assessment of Probing in the Presence of Gingivitis."

LAMBERTS, B. L. presented "A New Method to Assay Enzymes That Can Degrade Streptococcal Limit Glucans."

LEONARD, E. P. presented "The Effect of Diphosphonates on Alveolar Bone Loss in the Rice Rat."

FORMAL PRESENTATIONS OF RESEARCH MADE AT MEETINGS OF SCIENTIFIC SOCIETIES
RESULTS REPORTED AND/OR DISCUSSIONS LED (Continued)

MARCH (Continued)

LEONE, S. A. presented "An In Vitro Evaluation of the Cytotoxicity of Dental Implant Materials."

MANDEL, E. J. presented "The Effect of Anti-Inflammatory Drugs on the Loss of Alveolar Bone in the Rice Rat."

MUELLER, E. J. presented "The Bacteroides fragilis Group of Organisms and Periodontal Pockets."

SIMONSON, L. G. presented "Effects of Dextranase and other Proteins on Adherence of S. mutans to Hydroxyapatite."

WIRTHLIN, M. R. presented "The Treatment of Diseased Root Surfaces to Remove Cementum-Bound Endotoxin."

At the 57th General Session of the International Association for Dental Research, the Symposium on "Military Dental Research" was chaired by Captain Wirthlin and presentations were made by the following staff personnel:

CLARK, G. E. presented "Methods of Disease Prevention Applicable to the Military Population."

SHKLAIR, I. L. presented "Streptococcus mutans as a Cause of Oral Disease."

APRIL

SIMONSON, L. G. presented "Effects of Dextranase on S. mutans Adherence and Prevention of Dental Caries in Hamsters," at the American Association for Dental Research, Chicago Section.

MAY

The Conference on Preventive Dentistry and Patient Education was hosted by NDRI and presentations made by the following personnel:

CECIL, J. C. presented "Epidemiology of Dental Caries among Naval Recruits."

HANCOCK, E. B. presented "The Epidemiology of Periodontal Disease in Naval Recruits."

LAMBERTS, B. L. presented "The Structure of Glucans."

LEONARD, E. P. presented "New Chemotherapeutic Measures in Preventive Dentistry."

MUELLER, E. J. presented "Anaerobic Microorganisms and Periodontal Disease."

FORMAL PRESENTATIONS OF RESEARCH MADE AT MEETINGS OF SCIENTIFIC SOCIETIES
RESULTS REPORTED AND/OR DISCUSSIONS LED (Continued)

MAY (Continued)

SHKLAIR, I. L. presented "Streptococcus mutans and Its Glucans: How They Relate to Cariogenicity" and "Dental Floss Delivery of Fluorides."

SIMONSON, L. G. presented "Enzymatic Approaches to the Control of Dental Caries."

WIRTHLIN, M. R. presented "Plaque Control Instruction at a Naval Training Center," "Development of a Plaque Control Program," and "The Navy Periodontal Screening Examination."

AUGUST

HANCOCK, E. B. presented "Review of Graduate Research Projects," "Developing and Conducting a Research Project," and "Review of Navy Periodontal Research" Graduate Periodontics, Indiana University, School of Dentistry, Indianapolis, Indiana.

PARTICIPATION IN OTHER PROGRAMS

OCTOBER

The following staff personnel attended the Odontographic Society of Chicago meeting:

ANDERSON, D. M.
CLARK, G. E.
LEONARD, E. P.
LEONE, S. A.
WIRTHLIN, M. R.

A meeting of the Chicago Section of the American Association for Dental Research was attended by the following staff personnel:

GAUGLER, R. W.
LAMBERTS, B. L.
WIRTHLIN, M. R.

LEONE, S. A. attended the American Academy of Implant Dentistry Seminar and scientific meetings at the 2nd International Prosthodontics Congress, Las Vegas, Nevada.

NOVEMBER

The Great Lakes Dental Society meeting was attended by the following staff personnel:

ANDERSON, D. M.
CLARK, G. E.
HANCOCK, E. B.
LEONARD, E. P.
LEONE, S. A.

LAMBERTS, B. L., attended the Chicago Section IADR/AADR meeting at the American Dental Association Headquarters, Chicago, Illinois.

CECIL, J. E. and MANDEL, E. attended the 9845 Computer Programming and Operations Course, Hewlett-Packard Co., Loveland, Colorado.

WIRTHLIN, M. R. attended the Surgeon General Conference, Washington, D. C.

WIRTHLIN, M. R. attended the Naval Medical Research and Development Command Conference, Bethesda, Maryland.

MUELLER, E. J. attended the Hazardous Chemical Safety School (J. T. Baker Co.) in Naperville, Illinois.

PARTICIPATION IN OTHER PROGRAMS (Continued)

DECEMBER

The Oral and Dental Health Program Review at Naval Medical Research and Development Command, Bethesda, Maryland was attended by the following staff personnel:

SHKLAIR, I. L.
WIRTHLIN, M. R.

JANUARY

CECIL, J. C. attended the Tri-Service Medical Information Systems (TRIMIS) meeting held in Ft. Sam Houston, Texas.

FEBRUARY

The Mid-Winter meeting of the Chicago Dental Society was attended by the following staff personnel:

| | |
|------------------|-------------------|
| BAILEY, G. L. | LEONE, S. A. |
| CECIL, J. C. | MCCORMICK, J. M. |
| EDENFIELD, M. J. | MINTEN, M. L. |
| GALICH, J. W. | MINTEN, N. A. |
| HANCOCK, E. B. | NORTHERNER, R. A. |
| HOEFS, S. R. | PECOTTE, J. |
| HORTON, A. J. | REESE, W. V. |
| JOHNSON, R. K. | WIRTHLIN, M. R. |
| LEONARD, E. P. | |

WIRTHLIN, M. R. attended a luncheon meeting of Commanding Officers, Great Lakes, with RADM Chambers, BUPERS, Washington, D. C.

EEO meeting with Assistant to the Navy for EEO matters (Mr. A. A. Silva) was attended by:

CLARK, G. E.
ROUSE, M. J.
WIRTHLIN, M. R.

WIRTHLIN, M. R. and HANCOCK, E. B. attended the Mid-West Society Periodontology meeting.

The Chicago Section of the American Association for Dental Research was attended by the following staff personnel:

ANDERSON, D. M.
CECIL, J. C.
GAUGLER, R. W.
HANCOCK, E. B.
LAMBERTS, B. L.
LEONARD, E. P.
SIMONSON, L. G.
WIRTHLIN, M. R.

PARTICIPATION IN OTHER PROGRAMS (Continued)

FEBRUARY (Continued)

The following personnel attended the Reserve Naval Officer's Luncheon in Chicago, Illinois.

ANDERSON, D. M.
CECIL, J. C.
LEONARD, E. P.
WIRTHLIN, M. R.

MARCH

The Great Lakes Dental Society meeting was attended by the following staff personnel:

ANDERSON, D. M.
CLARK, G. E.
GALICH, J. W.
LEONE, S. A.

NELSON, L. D. attended the CNO and BUMED Financial Management Conference in Pensacola, Florida.

APRIL

The Chicago Section of the American Association for Dental Research was attended by the following personnel:

| | |
|-----------------|-----------------|
| CECIL, J. C. | SHKLAIR, I. L. |
| GAUGLER, R. W. | SIMONSON, L. G. |
| HANCOCK, E. B. | WIRTHLIN, M. R. |
| LAMBERTS, B. L. | |

WIRTHLIN, M. R. attended the First International Conference on Dentistry for Isolated Populations, in Milwaukee, Wisconsin.

GALICH, J. W. attended the Fleet and Marine Support Operational Management Seminar, National Naval Dental Center, Bethesda, Maryland.

NELSON, L. D. attended a meeting on "Overview of the Factor Evaluation System."

MAY

NDRI hosted an Open House and the Chicago Section of the American Association for Dental Research for their monthly dinner with speaker. Mr. Jon Van, science writer for the Chicago Tribune spoke on "Telling the Public What Goes on Behind Laboratory Doors." The following personnel attended:

PARTICIPATION IN OTHER PROGRAMS (Continued)

MAY (Continued)

ANDERSON, D. M.
CECIL, J. C.
CLARK, G. E.
GAUGLER, R. W.
HANCOCK, E. B.
LAMBERTS, B. L.
LEONARD, E. P.
LEONE, S. A.
PECOTTE, J.
SHKLAIR, I. L.
SIMONSON, L. G.
WIRTHLIN, M. R.

SIMONSON, L. G. received a Young Investigator Award from the Chicago Section, American Association for Dental Research.

LAMBERTS, B. L. passed the gavel of President of the Chicago Section, American Association for Dental Research to his successor.

The Great Lakes Dental Society meeting was attended by the following staff personnel:

CECIL, J. C.
CLARK, G. E.
WIRTHLIN, M. R.

The 79th Annual Meeting of the American Society for Microbiology in Los Angeles and Honolulu was attended by:

SHKLAIR, I. L.
SIMONSON, L. G.

NDRI hosted a BUMED conference on Preventive Dentistry and Patient Education. The professional staff of NDRI and representatives from nine various Naval Regional Dental Centers attended.

ANDERSON, D. M. attended the Edgar D. Coolidge Endodontic Study Club meeting in Chicago, Illinois.

LAMBERTS, B. L. attended the Lake Forest Chapter of Sigma Xi meeting.

COOPER, J. R. attended Operational Laboratory Animal Medical Problems course at Brooks Air Force Base, Texas.

JUNE

SHKLAIR, I. L. attended the Conference on Foods, Nutrition and Dental Health at the American Dental Association, Chicago, Illinois.

PARTICIPATION IN OTHER PROGRAMS (Continued)

JUNE (Continued)

ANDERSON, D. M. met with Dr. Kaare Langeland for consultation on a collaborative research project at the University of Connecticut, Farmington, Connecticut.

JULY

Introduction to Basic Gas Chromatography, Packard Technical Service Training facility, Downer Grove, Illinois was attended by:

MUELLER, E. J.
SIMONSON, L. G.

LAMBERTS, B. L. attended the Xith International Congress of Biochemistry in Toronto, Canada.

AUGUST

COOPER, J. R. attended Pathology of Laboratory Animals course at the Armed Forces Institute of Pathology, Washington, D. C.

HORTON, A. J. attended 21st AF NCO Leadership school at Dover Air Force Base, Delaware.

SEPTEMBER

COOPER, J. R. attended the 30th Session of the American Association for Laboratory Animal Science (AALAS), Atlanta, Georgia.

WORK UNITS - FISCAL YEAR 1979

- 61153N MR04120 MR0412002 0408 - Evaluation of Therapeutic Agents for the Prevention of Oral Bone Destruction in Navy and Marine Corps Personnel
- 61153N MR041.20.02 0441 - Prevention of Dental Disease in Naval and Marine Corps Personnel by Inhibiting Plaque Accumulation
- 62758N F51524 ZF51524012 0002 - Evaluation of Antimicrobial Agents on Disease Producing Organisms of the Oral Cavity of Naval Recruits
- 62758N F58524 ZF58524012 0006 - Evaluation of Navy Oral Health Programs
- 62758N F58524 ZF58524012 0026 - Evaluation of Factors in Saliva and Plaque of Caries-Free Recruits of Potential Therapeutic Applicability for Preventive Dentistry
- 62758N ZF51.524.012 0027 - Development of Therapeutic Methods to Prevent Oral Diseases of Naval and Marine Corps Personnel
- 63706N M0095PN M0095PN003 3008 - Evaluation of Expedient Procedures for Treating Dental Pulp Disease in Naval Personnel
- 63706N M0095PN M0095PN003 3010 - Wound Healing of the Supporting Tissues of Naval and Marine Corps Personnel
- 63706N M0095PN M0095PN003 3011 - Evaluation of Dental Implants as Applied to Navy and Marine Corps Personnel
- 63706N M0095PN M0095PN003 3016 - Navy Dental Technician Utilization
- 63706N M00935.PN M00935PN003 3017 - Dental Equipment Development and Evaluation for Fleet Health Care

INDEPENDENT RESEARCH WORK UNITS

- 61152N MR00001 MR0000101 0016 - Evaluation of Fluoride Concentration in Plaque of Naval Recruits
- 61152N MR00001 MR0000101 0017 - Clinical Evaluation of Methods for Detection and Treatment of Incipient Carious Lesions in Naval Recruits
- 61152N MR00001 MR0000101 0018 - Isolation of Anaerobic Microorganisms from Naval Personnel with Acute Periodontal Disease
- 61152N MR00001 MR0000101 0019 - The Prevention of Tooth Destruction by Low Molecular Weight Dextrans
- 61152N MR00001 MR0000101 0020 - Developing a Plaque Control Program for Naval Recruits and Dental Technicians

WORK UNITS - FISCAL YEAR 1979 (Continued)

61152N MR00001 MR0000101 0022 - An Evaluation of Cartilage Coating of
Implants as Applied to Navy and Marine Corps Personnel

61152N MR00001 MR0000101 0023 - Pathogenicity of Vaporized Dental Casting
Waxes in Naval Prosthetic Laboratory Environments



The military staff of NDRI.

RESEARCH PROGRESS REPORTS - FY 1979

NDRI-PR 78-01 Summaries of Research - Fiscal Year 1978

NDRI-PR 78-02 Venery and Vincent's - 15 Case Reports and Discussion

NDRI-PR 78-03 Research Abstracts of 1978

NDRI-PR 78-04 1978 Dental Student Research Reports

NDRI-PR 79-01 Use of Chlorhexidine Gluconate to Prevent Bone
 Resorption in the Rice Rat

NDRI-PR 79-02 Permeability of Cellophane Membranes to Parotid
 Proteins During Dialysis

NDRI-PR 79-03 The Hypermineralization of Diseased Root Surfaces

NDRI-PR 79-04 The Health of Naval Recruits: Periodontal Disease

NDRI-PR 79-05 Effects of Dextranases on Attachment of Streptococcus
 mutans to Hydroxyapatite

OTHER PUBLICATIONS

- Burt, B. A., Roder, D. M., Cecil, J. C. and Eklund, S. A. "Saliva-based colorimetric test as an index of gingival inflammation in epidemiologic studies." *Comm. Dent. Oral Epidemiol.* 6:290-295, 1978.
- Colson, P., Jarrell, C., Lamberts, B. L. and Smith, I. C. P. "Determination by Carbon-13 nuclear magnetic resonance spectroscopy, of composition of glucans synthesized by enzymes of the cariogenic organisms Streptococcus mutans." *Carbohydrate Research* 71: 265-272, 1979.
- Cooper, J. R. and Mattsson, J. L. "Control of radiation-induced emesis with promethazine, cimetidine, thiethylperazine, or naloxone." *Amer. J. Veterinary Res.* 40:1057-1061, 1979.
- Ezdinli, E., Simonson, K. L., Simonson, L. G. and Wasser, L. "T and B-RFC inhibiting factor in plasma from patients with active Hodgkins disease." *Cancer* 44:106-111, 1979.
- Hancock, E. B., Cray, R. J. and O'Leary, T. J. "The relationship between gingival crevicular fluid and gingival inflammation - A clinical and histologic study." *J. Periodontol.* 50:13-19, 1979.
- Lamberts, B. L. and Meyer, T. S. "Permeability of cellophane membranes to proteins during dialysis." *Experientia* 35:165-166, 1979
- Leonard, E. P. and Mandel, E. J. "Use of chlorhexidine gluconate to prevent bone resorption in the rice rat." *J. Dent. Res.* 58:672, 1979.
- Leonard, E. P. "Periodontitis." *Amer. J. Pathology* 96:693-696, 1979.
- Meyer, T. S., Lamberts, B. L. and Egan, R. S. "Structural studies of extracellular glucans of Streptococcus mutans by proton magnetic resonance." *Carbohydrate Res.* 66:33, 1978.
- Mueller, E. J., Mayo, C. V., Wirthlin, M. R., Hancock, E. B. and Shklair, I. L. "The apparent noninvolvement of the B. fragilis group in early periodontal disease." *J. Periodontal Res.* (in press).
- Simonson, L. G., Jackola, D., Lamberts, B. L. and Leonard, E. P. "Effects of two dextranase preparations on dental caries and alveolar bone loss in hamsters. *Pharmacology and Therapeutics in Dentistry* (in press).
- Simonson, L. G. and Jackola, D. R. "Effects of dextranases on attachment of Streptococcus mutans to hydroxyapatite." *Antimicrobial Agents and Chemotherapy* 16:9-12, 1979.
- Simonson, L. G. "Effects of dextranases on S. mutans adherence and prevention of dental caries in hamsters." *The Proc. Inst. Med. Chicago* 32:157, 1979.

OTHER PUBLICATIONS (Continued)

Wirthlin, M. R., Pederson, E. D., Hancock, E. B., Lamberts, B. L., and Leonard, E. P. The hypermineralization of diseased root surfaces. J. Periodontol. 50:125-127, 1979.

Wirthlin, M. R. "Preventive dentistry in the Navy." Dent. Abstr. 24:210, 1979.

DISTINGUISHED VISITORS

October

Captain Howard H. Fischer, DC, USN, Retired, Amery, Wisconsin.

November

Colonel Pryor, Naval Medical Research and Development Command,
Bethesda, Maryland.

Dr. Arthur Bahn, Southern Illinois University, Edwardsville, Illinois.

Dr. Burke Peterson, Preventive Dentistry Officer, Naval Regional Dental
Center, Great Lakes, Illinois.

Captain C. R. Norton, USN, Commanding Officer of Chicago Office of
ONR, Chicago, Illinois.

Dr. Kaare Langeland, University of Connecticut, Farmington, Connecticut.

December

Dr. S. Mukherjee, University of Illinois, Chicago, Illinois.

Dr. Morris Wagner, Microbiology Department, University of Notre
Dame, Notre Dame, Indiana.

Dr. Barbara Peri, University of Chicago, Medical School, Chicago,
Illinois.

Dr. H. Busch, University of Chicago, Chicago, Illinois.

January

Dr. Gary Kraus, University of Health Sciences/The Chicago Medical
School, North Chicago, Illinois.

Dr. K. Michael Peddecord, VA Hospital, North Chicago, Illinois.

February

Dr. John Vinton, Dean of Students, Hamline University, St. Paul,
Minnesota.

Mr. Peter Pipe, Consultant on Education, Sunnyvale, California.

March

Dr. Gerald Desmer, Director, Community Dentistry Department, Lake
County Health Department, Waukegan, Illinois.

April

Mrs. Bellinger, Navy Relief Society, Great Lakes, Illinois.

Mrs. K. Gerber, Midwest American, Des Plaines, Illinois.

Mrs. Nord, American Red Cross, Great Lakes, Illinois.

Captain W. R. Cotton, Chairman, Dental Sciences Department, Naval
Medical Research Institute, Bethesda, Maryland.

DISTINGUISHED VISITORS (Continued)

May

Dr. John Tullner, Veterans Administration Regional Medical Center.
Dr. Perry A. Rattcliff, D.D.S., Scottsdale, Arizona.
Dr. F. P. Singh and Dr. R. L. McGee, VA Hospital, North Chicago,
Illinois.
Dr. Saul Needleman, Highland Park, Illinois.

The NDRI Open House, held in conjunction with the Chicago Section American Association for Dental Research meeting, was attended by 20 visitors from Dental Schools at Marquette University, Milwaukee, Wisconsin and Northwestern University, Chicago, Illinois; Naval Regional Dental Center, Great Lakes, Illinois; and COE Laboratories, Inc.

NDRI hosted a BUMED conference on Preventive Dentistry and Patient Education, the following attended:

Commander John M. Allen, DC, USN, NRDC, Orlando Florida
Captain John W. Anderson, DC, USN, NRDC, San Francisco,
California.
Commander Alfred E. Brandt, DC, USN, NNDC, Bethesda, Maryland.
Commander John R. Lohr, DC, USN, NRDC, Parris Island, S. C.
Captain Samuel S. Lusk, DC, USN, NRDC, Camp Lejeune, N. C.
LCDR Burke B. Peterson, DC, USN, NRDC, Great Lakes, Illinois.
Captain Raymond C. Terhune, DC, USN, NRDC, San Diego,
California.
LCDR Mark P. Tytell, DC, USN, NRDC, Norfolk, Virginia.

June

CDR D. Hall, DC, USNR-R, University of Iowa.
Mr. William Gwinn, ADEC, Newberg, Oregon.
Mr. J. Latchaw, ADEC, Newberg, Oregon.
Dr. Anthony Volpe, Colgate Palmolive Co.
Captain J. F. Kelly, DC, USN, Head Oral and Dental Health Programs,
Naval Medical Research and Development Command, Bethesda,
Maryland.
Mr. William Shorp, Hewlett-Packard Company, Fort Collins, Colorado.

July

Mr. William Ward, Dentsply, York, Pennsylvania.

August

CDR W. Hohlt, DC, USNR-R, Indianapolis, Indiana.
CDR Dale Nickelsen, DC, USNR-R, Elgin, Illinois.
Seventeen dentists from the Sixth Annual Latin American Conference
at the University of Illinois, Chicago toured NDRI.
RADM James Enoch, DC, USN, Inspector General, Dental, Bureau of
Medicine and Surgery, Washington, D. C.

DISTINGUISHED VISITORS (Continued)

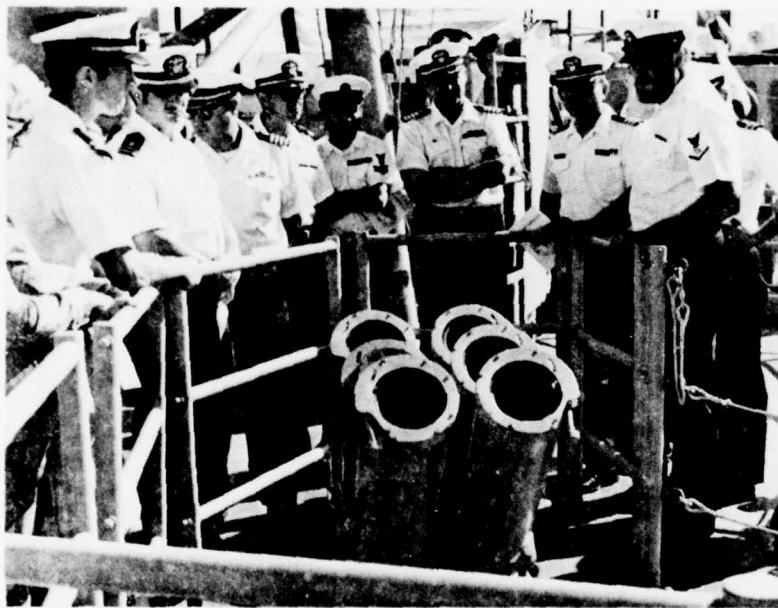
August (Continued)

LCDR P. Ackley, MSC, USN, Bureau of Medicine and Surgery, Washington,
D. C.

Colonel Phillip E. Winter, MC, USA, Office of the Under Secretary,
Department of Defense, Research and Engineering, Washington, D. C.

SEPTEMBER

LCDR R. Malcolm, SC, USN, Great Lakes, Illinois.



One tour group of NDRI staff members during the
visit to the USS O. H. Perry (FFG-7).

STATEMENT OF SIGNIFICANT ACCOMPLISHMENTS

CLINICAL INVESTIGATIONS DEPARTMENT

(Dental Care Delivery Division - Health Management Branch)

The monitoring of the oral health status of naval recruits at Great Lakes is continuing. In 1976, there were 44,970, in 1977 34,986, in 1978 28,510 and in 1979 to date, 19,230 naval recruits onboard Recruit Training Center, Great Lakes. We have selected, from the pool of naval recruits, approximately two percent to participate as volunteers in clinical examinations. NDRI currently has a file with longitudinal and cross-sectional data for 1186 subjects on which the analysis has been computed. Data for approximately 300 subjects added for FY 1979 are awaiting analysis.

With the aid of the computing facility and personnel at the Naval Health Research Center (NHRC), San Diego, California, caries incidence data for 354 subjects has been analyzed. In an attempt to predict those recruits at entry who are most at-risk for new caries attack, several pre-enlistment personal characteristics of naval recruits (i.e. Screen Score, Mental Group Score, AFQT Score, education level) have been correlated and tested with respect to overall caries attack rate (CAR) and posterior proximal surface caries attack rate (PPCAR) and other dental caries indices (i.e. DMFS, DS, MS, FS). Those subjects with a low Screen Score, low Mental Group Score, and low AFQT score have a significantly increased number of U-lesions (dental caries >3/4 through dentin) at entry, increased CAR and PPCAR at six months, and greater number of decayed tooth surfaces at entry into the Navy.

Education level attained at time of recruitment has shown to be an important variable related to the dental decay status. Recruits who are not high school graduates have significantly more missing teeth, more decayed tooth surfaces and higher DS/DMFS ratios.

The prevalence of the periodontal diseases among the sample was universal -- no subjects were observed with healthy gingiva. Gingival inflammation was found at almost every site examined (i.e. six selected teeth per subject) and the inflammation encircled nearly 90 percent of the teeth examined. Gingival pockets identified were primarily three to five millimeters deep associated with molars and premolars, and were found in four of every five recruits.

There were few subjects seen with acute conditions such as necrotizing gingivitis, primary herpetic gingivostomatitis or apthous ulcers, the prevalence being less than one percent of the sample. Only two percent of the sample were considered to have a frank, acute pericoronitis requiring professional intervention.

Navy Plaque Index (NPI) scores were high for the entire sample. From the geographic distribution of NPI scores, it appeared that few subjects performed interproximal or gingival margin cleansing on a daily basis.

STATEMENT OF SIGNIFICANT ACCOMPLISHMENTS (Continued)

CLINICAL INVESTIGATION DEPARTMENT (Continued)

An innovative plaque control program was initiated in March 1979 to determine if mass instruction directed toward fulfilling the felt needs of recruits and later, service school students, could improve the oral disease status and oral hygiene habits of participants. Approximately 400 recruits were asked to participate. The plaque control program was implemented in the preventive clinic areas of the Naval Regional Dental Center, Great Lakes, IL. Initial examinations have been completed and two follow-up examinations are now in progress. Before and after comparisons will be made to determine if the plaque control program was effective in improving the gingival and periodontal health of participants.

A Hewlett-Packard 9845-A desk-top calculator system was received and finally placed in operation during January 1979. The capabilities of the memory of the HP 9845-A enable the division to store and analyze data sets of 5000 data points rapidly and reliably. Software programs containing both parametric and non-parametric statistical tests have been written and debugged. With the optical scan capabilities of the equipment, it is anticipated that a file system can be developed to predict the future increment of dental disease among naval personnel.

Microfiche from the Enlisted Personnel Management Center in New Orleans, LA have been received which enables the division to follow-up on naval personnel throughout the world. A new MILPERS data processing system enables NDRI to sample NTC, Great Lakes staff personnel and monitor their oral health status on a long term basis (i.e. 2 years or more). The microfiche and MILPERS systems should decrease the time necessary in "finding" naval personnel for follow-up examinations.

A 16 mm motion picture camera has been procured and is undergoing overhaul/modification for coupling with a pulse generator to allow time-lapse photography. It will be used to record traffic patterns, operating positions, and time intervals in measuring the effectiveness of specially-trained endodontic auxiliaries. The endodontist's performance with various auxiliary teams of generally-trained and specially-trained Navy dental technicians will be evaluated. One or more dental operatories in both conventional and radial configuration will be employed in the study.

(Facilities Support Branch)

The Marine Corps has selected new 8' x 8' x 20' rigid and collapsible controlled-environmental containers for a modular shelter system, which meets international shipping standards for size. Developmental drawings were obtained and working drawings prepared. A wooden mock-up was prepared by NDRI staff for use in designing a dental version of the Marine Corps Expeditionary Shelter System (MCESS). Existing equipment from the Authorized Dental Allowance List (ADAL) was obtained with which to configure two operatories in the shelter. The presently available field light was found to give poor illumination and was mounted on an unsteady tripod. A fiberoptic light mounted on the field chair, was found to be a suitable

STATEMENT OF SIGNIFICANT ACCOMPLISHMENTS (Continued)

CLINICAL INVESTIGATION DEPARTMENT (Continued)

replacement. Initial treatment of patients has indicated that the ADAL arrangement, with modifications, is an improvement over the unaltered system. However, all categories of the field equipment are presently undergoing refinement to make each item smaller, lighter, and less expensive. More extensive evaluation under field conditions is anticipated in the near future.



RADM J. ENOCH, DC, USN; Inspector General, Dental
being briefed by CAPT M. R. Wirthlin about the
fiberoptic light in the wooden mock-up MCESS.

The highspeed, air-driven dental handpieces have had a profound effect on the practice of dentistry. They have been a possible uncontrolled link in the chain of sepsis between patients however, as only wiping on the surface with alcohol-moistened sponges has been recommended. Handpieces which were claimed to be autoclavable by their manufacturer were immersed in suspensions of B. globigii heat-shocked spores and then in serum. When dry, they were placed in paper bags and given a routine autoclaving. After cooling, they were immersed in culture media and incubated for seven days. There was no growth. In controlled laboratory trials the handpieces were autoclaved, lubricated according to the manufacturer's instructions, and the free-running speed measured. The handpieces were subjected to 300 cycles, simulating three month's use. After about 150 cycles there began a fall in speed performance. The handpieces which were not autoclaved had essentially no change in performance over the 300 cycles. In three month clinical trials, dental officers evaluated the performance of the handpieces when autoclaved between each patient. It was found absolutely necessary to follow the manufacturer's instructions explicitly to prevent breakdown; even so,

STATEMENT OF SIGNIFICANT ACCOMPLISHMENTS (Continued)

CLINICAL INVESTIGATION DEPARTMENT (Continued)

mechanical problems did occur. Some dental officers noted problems with "torque" or "cutting power," subjectively. There is the need to develop a laboratory performance test which relates to what dentists call torque. Sound level measurements of the operating handpieces showed that they exceeded 85 decibels in the A-weighting band, and at 4, 8, and 16 kilocycles frequency bands. Both cutting power and noise may be related to the design of the turbine, and are appropriate subjects for engineering development by the industry.

(Oral Diseases Division - Dental Caries Branch)

Evaluation of conservative pulp treatment for teeth with deep caries is continuing. Of the 1,466 recruits examined so far, 265 individuals presented a total of 467 restorable "U" lesions. Thus in 1,000 naval recruits, there are 319 "U" lesions in the oral cavities of 181 subjects which might go to general dentists for restoration; other "U" lesions would be scheduled for removal as unmanageable.

Comprehensive diagnostic data were obtained by the investigators and treatment data were recorded for the "U" lesion tooth according to the clinician's choice of treatment methods. By evaluating radiographs, histories and results of clinical tests at yearly intervals, the most reliable procedures and materials for treating pulp disease under deep caries will be determined.

Some of the teeth have been extracted while others underwent total or partial pulpectomy. The number of "U" lesions treated during the study by leaving the pulp intact was 229 or 77%. Pulp treatments for these teeth were: complete caries excavation, no exposure, 164; complete excavation, direct pulp cap, 36; and indirect pulp cap, 29. Data for one-year recalls indicated 73% success in "U" lesion treatment while there was a 65% success note for treatment after two years. Success was evaluated by absence of symptoms and absence of, or improvement in, radiographic evidence of physical pathology. As the yearly recall data base increases, successful treatment of the lesions will be further categorized according to the type of pulp therapy and materials used in the treatments.

In the diagnostic phase of this study, an attempt was made to correlate results of clinical symptoms, history and tests with the health of the dental pulp as determined histologically. Clinical and histologic evaluations have been completed for 176 teeth. Preliminary analysis of results indicates that it is possible to predict, with a high degree of accuracy, the reversibility of dental pulp disease due to caries with diagnostic methods in current usage. Radiographic enlargement of the apical periodontal ligament space, a history of severe pain lasting more than one minute, a history of pain provocation by pressure and lack of response to two or more hot/cold/electrical vitality tests are strong indicators of irreversible pulp disease. Multivariate analysis is being conducted to determine the contribution of each variable to the final diagnosis. In no instance did caries cause a severe pulpal

STATEMENT OF SIGNIFICANT ACCOMPLISHMENTS (Continued)

CLINICAL INVESTIGATION DEPARTMENT (Continued)

inflammation, or a condition considered to be irreversible until the decay had proceeded through three-fourths the dentin thickness by radiographic measurement.

Work is also progressing to determine the agent(s) and mechanism whereby the dental caries process induces pulp disease. Permeability factor toxin (PF) has been isolated from carious dentin extracts. Extracts were prepared from carious dentin collected from the "U" lesions of teeth undergoing restorative treatment. The PF was solubilized in phosphate-buffered saline and filtered to remove microorganisms. Presence of PF was demonstrated by development of a characteristic wheal reaction in rabbit skin. The current isolation technique involves treatment by; first, anionic exchange chromatography (Whatman DE-52, diethylaminoethyl cellulose), second, molecular gel filtration chromatography (LKB, Ultrogel Aca 54), and third, hydroxylapatite adsorption chromatography (Bio-Rad, Bio-Gel HT). The PF molecule appears to be an acid protein with an isoelectric pH of 4.5 and a molecular weight of approximately 35,000.

A preliminary trial of the effect of PF in primate teeth on pulp tissue was completed. Buccal cavities were prepared to within approximately 1 mm of the pulp of two monkey molar teeth. Then 0.15 ug PF in phosphate buffered saline (PBS) in filter paper discs were applied to the pulpal wall of the cavity preparations. The PF-impregnated paper discs were sealed against the pulpal floor by telfon (TFE) and spherical amalgam. Two control molar teeth were treated in the same manner using PBS without PF. After 24 hours, the teeth were removed. Microscopically, minimal disruption of the pulp odontoblastic layer was seen under the cavity preparations in both control and PF-treated teeth. However, striking differences in vascularity were noted in the PF-treated pulp compared to control-treated pulp tissue. Vessels engorged with red blood cells and polymorphonuclear leukocytes were noted throughout the coronal pulp. An infiltration of plump plasma cells could be seen throughout the pulp tissue, some with very granular cytoplasm. More experiments are required in order to make conclusions about why the plasma cells were there. Russell bodies were observed to be scattered diffusely in all the histologic sections of PF-treated pulp tissue. There were no repair changes observed in the fibrous connective tissue after only 24 hours.

More trials of the affect PFhas on pulp tissue are now being conducted in primate teeth to determine optimum test conditions and treatment intervals for best observation of both acute and chronic influences on the dental pulp. Preliminary observations indicate caries PF, presumably produced by microorganisms, is capable of causing adverse inflammatory changes in the dental pulp. It may be the factor, or one of several factors, which cause inflammation of pulp tissue and advance the caries progression through dentin.

A clinical method for the detection and conservative treatment of beginning carious lesions in the teeth of naval recruits was evaluated. Before a cavity has formed, these lesions appear as white spots in the enamel. Laboratory

STATEMENT OF SIGNIFICANT ACCOMPLISHMENTS (Continued)

CLINICAL INVESTIGATION DEPARTMENT (Continued)

and clinical evaluations were made of eighteen dyes, viewed with various illumination sources for their ability to render beginning lesions visible to the naked eye. Sodium fluorescein (2%) in 30% ethanol, topically applied to clean teeth and illuminated by a fiberoptic ultraviolet light was determined to be the best detection system for clinical use. The physical differences between lesions which absorb the dye and those which do not were determined with both light and scanning electron microscopy. Those lesions which did not take up dye had a smooth surface while the dye-marked specimens exhibited rough and porous enamel surfaces. Those which absorbed the dye also had sub-surface softening. In a ten-month clinical study carried out with 70 naval recruit volunteers, dye-detectable lesions were treated by burnishing stannous fluoride crystals into them. Although many treated lesions became undetectable at subsequent re-examination, there were too few subjects available at the end of the study to allow statistical evaluation of treatment efficacy compared with untreated lesions. However, it was noted that subjects in both treated and untreated groups developed newly detectable lesions in other sites during the interval, emphasizing the need for simple, conservative treatment. A longer clinical trial in a more stable population is necessary to determine if burnished stannous fluoride can totally arrest incipient tooth decay.

(Periodontal Diseases Branch)

The work on the location of the periodontal probe tip in health and disease was completed. Elastics were placed around the incisor teeth in Rhesus monkeys to induce inflammation and loss of attachment. The bands were removed, the pocket depths recorded and bands replaced every two weeks. After 18 weeks, inflammation, recession and loss of connective tissue attachment were evident on the facial of the maxillary incisors. There was inflammation but no loss of attachment on the facial of the mandibular incisors. Two weeks after final band removal, pocket depths were recorded using gold-coated acrylic replica probes luted to 8 mandibular incisors (gingivitis) and 8 maxillary incisors (periodontitis). Block sections including the tooth, probe, facial gingiva and crest of the alveolar process were removed, fixed, decalcified and processed for viewing by light microscopy. In the gingivitis specimens there was a mild to moderate inflammatory infiltrate which extended apically to the level of the CEJ. The crevicular epithelium exhibited rete ridge formation and micro-ulcerations were evident. The vessels of the crevicular plexus were enlarged and engorged with red blood cells. The tip of the probe was contained in a pouch of epithelium and connective tissue coronal to the CEJ. The epithelium about the tip of the probe was about 10 cells thick but the cells were very distorted and flattened. In the periodontitis group there was a moderate to dense inflammatory infiltrate. The tip of the probe lay in a pouch of extremely thinned and flattened epithelium and distorted connective tissue at the level of the connective tissue attachment. The epithelium was discontinuous in some areas at the tip and just lateral to the tip of the probe. It was concluded that probing depth estimates indicated the level of a healthy dentogingival junction but do not differentiate between epithelial and connective tissue attachment levels. Thus, in normal

STATEMENT OF SIGNIFICANT ACCOMPLISHMENTS (Continued)

CLINICAL INVESTIGATION DEPARTMENT (Continued)

gingiva, as reported previously, and in gingivitis, probing indicated epithelial attachment levels while in periodontitis probing indicated connective tissue attachment levels.

Biochemical analysis of standardized gingival wounds of atraumatic linear incision indicated a depression of the collagen synthesis rate immediately after wounding. From two to fourteen days postoperatively the collagen synthesis rate returned to the level of unwounded gingiva, but at 21 days the rate was significantly elevated. The force required to separate the gingival tissue from the tooth was also decreased immediately following wounding but by the second postoperative day had returned to near unwounded levels. Thus, although the gingival tissues rapidly regain strength, the connective tissue repair followed at a later interval. Histologic and histometric analyses of these wounds are underway.

A method to deliver a known, reproducible impact to the gingiva resulting in laceration of the soft tissues has been developed. These laceration wounds were evaluated at 0, 2, 7, 14 and 21 days postoperatively in monkeys. At each time the wounds were tested for rupture strength and samples were removed for collagen analysis. In addition, specimens were removed for histometric and histological evaluations. The results from these tests will be compared with those from linear incision wounds to compare healing rates and methods of repair in wounds produced by differing degrees of trauma. The evaluation and analysis of these wounds continues.

Extracted human teeth with areas exposed to periodontal disease processes were scaled free of calculus in the laboratory and sectioned into mesial and distal halves. The diseased area of one half of each tooth was treated with phosphate buffered saline. The diseased root surface of the other half was treated with either sodium desoxycholate (2%), Cohn plasma fraction IV-1 (5%) or by a combination of desoxycholate followed by Cohn IV-1. The teeth were incubated in a human gingival fibroblast cell culture for 48 hours, and the number of attached fibroblasts per unit area were counted. The combination treatment of desoxycholate followed by fraction IV-1 produced significant differences from the saline treated controls, and larger differences than either treatment alone. This in vitro test indicated that this treatment method provided a biologically acceptable surface for the attachment of fibroblasts without the use of vigorous root planing or the use of harsh chemicals. This treatment was next tested in an animal model system.

Surgically created periodontal pockets in maxillary teeth of monkeys were treated using a standardized flap approach. The root surfaces were treated with either sterile phosphate buffered saline or a combination of a 2% solution of sodium desoxycholate followed by a 5% solution of Cohn plasma fraction IV-1. At various time intervals between 0 and 21 days, the wounds were tested for rupture strength and samples were removed for collagen analysis. Other specimens were obtained for histologic and histometric evaluations of the effect of treatment on the establishment of a new attachment apparatus. These evaluations are currently underway.

STATEMENT OF SIGNIFICANT ACCOMPLISHMENTS (Continued)

CLINICAL INVESTIGATION DEPARTMENT (Continued)

(Trauma and Surgical Problems Division)

A six month study was completed in primates to test tissue compatibility of five dental implant materials. Aluminum oxide in three grades of porosity, surgical grade ticonium and titanium were studied. Sixteen cylinders, 1 x 3 mm, of each material were placed randomly in all jaw quadrants of four Macaca fascicularis primates. The eighty implants were surgically placed in bone, and the gingiva allowed to heal over them by primary intention. At ten weeks, the implants were surgically exposed to the oral cavity. Evidence of inflammation was assessed weekly. At 6 months, the implants were removed in block section and evaluated histologically. The percentage of each type remaining in situ after 6 months is as follows: Ticonium 66.7%; Dense aluminum oxide, 62.5%; Titanium 43.8%; Semi-dense aluminum oxide, 31.3%; and porous aluminum oxide, 18.8%. Chi square analyses revealed that differences in retention of material types were significant ($P < 0.05$). Histologically, porous aluminum oxide had the least evidence of inflammation. In all cases, it was submerged into bone suggesting excellent biocompatibility with bone. This agrees with the suggestion that porous material will allow greater penetration of bone. However, earlier studies at this Institute suggested that porous material will also allow penetration of saliva through the material if the implants are exposed to the oral cavity. This study supports that view and suggests that dense aluminum oxide would be a better choice of material than porous.

It is believed that the integrity of the implant -- host tissue interface could be maintained if living cartilage cells, which may be immunologically acceptable to the host, could be cultivated in a continuous layer over the implants before they are placed within bony tissue. A study was undertaken to cultivate primate cartilage cells from surgical biopsies, develop techniques to enhance production of the matrix material they secrete, induce growth of the cells on dental implants and finally, to evaluate the cell-coated implants in the jaws of primates. A line of primate cartilage cells has been established which will survive freezing, thawing and re-culture. Stains and scanning electron microscopy are used to evaluate quantities of secretions produced by the cells. Various media and supplements have been evaluated, some of which appear to induce formation of an observable extracellular material. Scanning electron microscopy has demonstrated that cartilage cells will grow densely on both unplated and carbon-plated titanium implants. Evaluation of cartilage-coated implants in primates will begin after laboratory procedures are perfected to reliably cultivate a dense depositon of cells around the superficial neck of implants, the most critical area of attachment in host tissues.

STATEMENT OF SIGNIFICANT ACCOMPLISHMENTS (Continued)

SCIENTIFIC DEPARTMENT

(Biochemistry Division)

Dental plaque contains fluoride, but little is known of the role this plaque fluoride plays in the prevention of dental disease. To evaluate the effect of the ion, samples of interproximal plaque from recruits with widely different caries experience were examined to determine the total fluoride present, how tightly the ion is held in the plaque, and the ability of the plaque to absorb more fluoride from 1 ppm or 225 ppm solutions. The effect on these factors due to the previous exposure of the recruits to fluoridated water supplies was also investigated, using the 1975 Fluoridation Survey of the U.S. Public Health Service to determine the fluoridation status of the hometown of each recruit. A total of 165 recruits were sampled, 47 caries-free (DMFT=0), 57 caries-active (DT>5, mean of 10.3 ± 3.9 active lesions per man), and 61 with low caries prevalence (DMT=0, $0 < DT < 5$, Mean of 1.7 ± 0.9 active lesions per man). Of these, 71% (36 caries-free, 34 caries-active, and 47 low caries) of the recruits came from areas where water supplies were either adjusted to the optimum fluoride concentration, or naturally contained at least 0.7 ppm fluoride.

The 47 caries-free individuals had a significantly greater mean fluoride content in their plaque compared to the plaque of caries-active individuals (8.2 versus 4.7 ppm). The plaque fluoride content was greatest with plaque of caries-free recruits from fluoridated areas (9.0 ppm), and least with plaque from caries-active recruits from non-fluoridated areas (4.2 ppm). The plaque of the low caries group had an intermediate concentration, 6.2 ppm, which was not statistically different from either the caries-free or caries-active groups. Thus, the greater the caries experience of the group, the lower are the fluoride levels found in the plaque. There was no difference in how tightly the ion was held in plaque from the three groups. In each group, about 60% of the ion was extractable with water, 33% with dilute acid, and the remainder required complete digestion of the plaque in hot, concentrated acid for release. The relative absorption of fluoride from a 1 ppm solution by the plaque of the three groups was inversely related to their relative fluoride content. The plaque of the caries-active group, which contained the least fluoride, absorbed significantly more of the ion than plaque from the caries-free group (1.54 versus 0.97 ng F absorbed per mg plaque). The low caries group again fell between the other groups, 1.32 ng F absorbed per mg of plaque, and its value did not statistically differ from either of them. These results indicate a saturation level for fluoride in plaque which may not vary with the caries experience of the individual. Samples of plaque from another 97 recruits, 27 caries-free, 38 caries-active (9.7 ± 4.1 active lesions per man), and 32 with low caries prevalence (1.4 ± 0.7 active lesions per man) were examined for absorption of fluoride from a 0.05% sodium fluoride (225 ppm) solution. The mean absorptions from solution were 236, 231, and 220 ug F per mg of plaque for samples of the caries-free, low caries, and caries-active groups, respectively. These values were not statistically different,

STATEMENT OF SIGNIFICANT ACCOMPLISHMENTS (Continued)

SCIENTIFIC DEPARTMENT (Continued)

again indicating that saturation levels do not vary with caries experience. The results of this work provide evidence that higher fluoride levels in the plaque are associated with lower caries prevalence, but that there is no difference in how tightly the ion is held, or in its absorption from solution. This suggests that frequent contact with fluoride solutions may increase the fluoride concentration in the plaque and reduce the susceptibility of the individual to disease.

Ten laboratory strains of oral microorganisms and 17 recent clinical isolates were examined for their ability to concentrate fluoride from a 1 ppm fluoride solution. The organisms included five laboratory strains and six isolates of Streptococcus mutans, two laboratory strains and four isolates of Streptococcus sanguis, two laboratory strains and seven isolates of Actinomyces viscosus, and one laboratory strain of Actinomyces naeslundii. The two laboratory strains of S. sanguis and two of the five laboratory strains of S. mutans concentrated the ion more than 4-fold greater than the surrounding media. The other three S. mutans strains and all of the laboratory strains of Actinomyces concentrated the fluoride 2- to 3-fold. The clinical isolates of Actinomyces concentrated the ion to similar levels as the laboratory strains of this organism, but the clinical isolates of the streptococci concentrated fluoride less than 2-fold, which was significantly less than any other of the laboratory strains examined. The results indicate that fluoride accumulation is a common property of most of the oral microorganisms tested, although the amounts of the ion taken up vary greatly among strains.

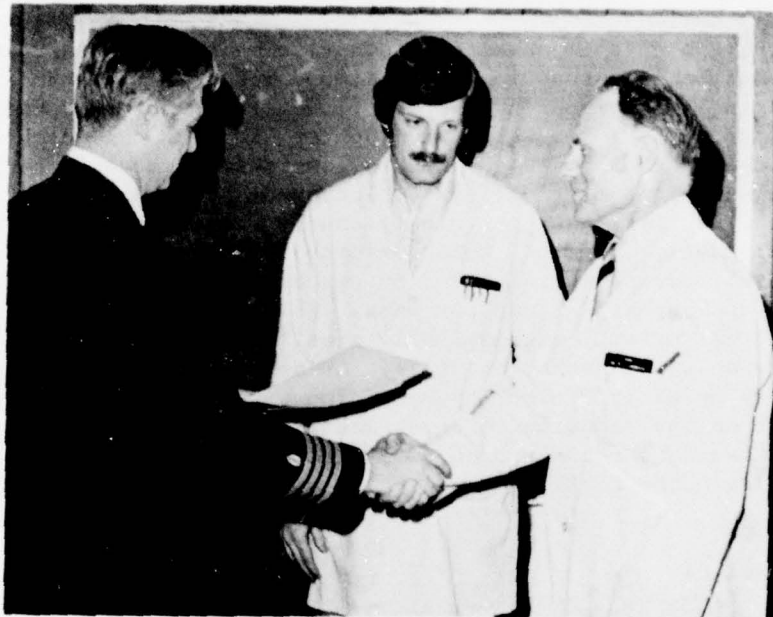
The oral organism, Streptococcus mutans, can synthesize sticky glucans from sucrose which contain high proportions of α -1, 3 glucosidic linkages. These glucans promote the adherence of the bacterial cells to each other and to tooth surfaces. Enzymes such as α -1, 3 glucanases, which could degrade the glucans, might be useful oral therapeutic agents. We have conducted a search for α -1, 3 glucanase-producing organisms in interdental plaque samples, using a water-insoluble "blue limit glucan" as substrate. This substrate, prepared by complexing dextranase-degraded streptococcal glucan with Cibacron Blue dye, had been found to be useful during earlier tests of soil samples for detecting glucanase-producing organisms cultures in liquid media.

Surveys were conducted on plaque samples from 75 caries-free, 59 moderately caries-active, and 69 highly caries-active naval recruits. Eleven additional plaque samples were taken directly from open "U" lesions. None of the samples showed clearcut evidence of α -1, 3 glucanase-producing organisms, although trace amounts of glucanase activity appeared to be present in certain samples. It was concluded that few, if any organism normally found in dental plaque elaborate α -1, 3 glucanases. No evidence could be found to indicate that these enzymes play a significant role as natural oral factors protecting against dental decay.

STATEMENT OF SIGNIFICANT ACCOMPLISHMENTS (Continued)

SCIENTIFIC DEPARTMENT (Continued)

Saliva contains certain proteins as well as a tetrapeptide called "sialin" which may be converted by oral bacteria to basic metabolic products that could act to buffer bacterial acids. We have initiated a study to determine whether these salivary components may function in vivo as significant anti-caries agents. Whole saliva samples from 52 caries-free and 52 caries-active subjects were assayed for pH changes with time, to determine whether there might be differences in mean profiles of pH versus time. The measurements were made on paired caries-free/caries-active samples, using in each case salivary sediment and glucose mixed with salivary supernatant, or with arginine or water as controls. The tests were conducted in two series on different groups of 26 caries-free and 26 caries-active subjects, using levels of 0.05% and 0.005% glucose respectively for each series.



Dr. B. L. Lamberts and Dr. L. G. Simonson receiving a patent award from Captain M. R. Wirthlin.

The mean pH profiles for the salivary supernatants of the caries-free subjects were higher in each series than those for the caries-active subjects. Analysis of covariance indicated that the differences between the caries-free and caries-active profiles of each series were statistically significant. Work is now in progress to identify the factor, or factors, causing the differences in the mean pH profiles for the caries-free and caries-active subjects.

STATEMENT OF SIGNIFICANT ACCOMPLISHMENTS (Continued)

SCIENTIFIC DEPARTMENT (Continued)

(Histopathology Division)

In collaboration with the Division of Veterinary Sciences, a study was initiated to determine the effect on lung tissues of the inhalation of hydrocarbons produced by the vaporation of dental casting waxes. A pilot study was first conducted to test the materials and methods to be employed. Results of this pilot study indicated that exposure of rats to the vapors of dental casting wax at concentration of .49 g/cu foot or above resulted in significant pathologic effects. Using information gained in the pilot study, an experiment was conducted using concentrations of dental casting wax actually found in naval dental laboratories. Preliminary findings indicate that under these conditions the lung tissues of exposed rats were not significantly different from non-exposed controls with respect to enzyme concentrations, number of macrophages recovered or morphologic comparisons.

The study comparing the effectiveness of preventive measures for arresting and controlling oral bone destruction is nearing completion. Dextranases, steroids and aspirin-like compounds have all proved ineffective in reducing the bone loss occurring as a result of periodontal disease. One diphosphonate (Cl₂MDP) reduced the rate of bone loss but is considered unacceptable as it demonstrated clear signs of toxicity. Chlorhexidine gluconate continues to prove the most effective agent for significantly reducing alveolar bone loss in the animal model. To date, chlorhexidine has been tested in 0.2%, 1% and 2% concentrations and administered by swabbing from as few times as once per month to as many as 5 times per week. While all concentrations showed some beneficial effect, statistically significant reductions in bone loss occurred only at a concentration of 2%. At concentrations of less than 2% neither delivery by Water Pic nor by combining with 10% SnF₂ had any appreciable affect on the reduction of bone loss. Hibiclense, the FDA approved chlorhexidine-containing surgical scrub, was also ineffective when used at a 0.2% chlorhexidine concentration.

(Microbiology Division)

Spirochetes are suspected of playing a role in the initiation and progression of acute periodontal disease. Specimens were collected from 9 patients with acute necrotizing ulcerative gingivitis (ANUG) and 24 healthy control patients in an attempt to isolate and identify spirochetes. Two sampling devices, a modified syringe barrel and a sterile section of plastic tubing, were used to collect specimens. Both devices were flushed with oxygen-free gas to prevent exposure of specimens to atmospheric oxygen. Endodontic broaches were held within each device and the tip of the broach was extended from the sampling device to collect the specimen.

Spirochetes were isolated from all ANUG patients but not from the healthy control patients. Only enriched veal infusion agar or broth was able to support the growth of spirochetes. These organisms were isolated with membrane filters and subcultured on veal infusion broth. All of the spirochetal isolates were identified as Treponema oralis by biochemical characterization and gas chromatographic analysis of culture end-products.

STATEMENT OF SIGNIFICANT ACCOMPLISHMENTS (Continued)

SCIENTIFIC DEPARTMENT (Continued)

Broth dilutions were used to determine the susceptibility of the T. oralis isolates to penicillin G, metronidazole, Teepol and a solution of sodium lauryl sulfate and EDTA in phosphate buffered saline. Those concentrations which inhibited growth of motile organisms, as determined by darkfield microscopy, were considered inhibitory. Inhibitory concentrations observed were: penicillin G > 1 unit/ml; metronidazole, 0.125 ug/ml; Teepol, 0.625%; and sodium lauryl sulfate-EDTA solution, 0.14 mM and 0.5 mM respectively.

The results of this trial indicate that very low concentrations of surface active agents inhibit spirochetes in vitro. This low inhibitory concentration would provide a potential high safety ratio of toxic/therapeutic dose for the treatment of necrotizing gingivitis without the use of antibiotics.



Dr. I. L. Shklair explaining microbiological techniques to two dentists from the Sixth Annual Latin American Conference touring NDRI.

Streptococcus mutans produces water-soluble and insoluble glucans when grown in the presence of sucrose. Those glucans, particularly the insoluble glucans, promote the development of dental plaque and appear to be important in the development of dental decay.

Procedures were investigated to find a rapid, accurate and reproducible method for measuring glucan synthesis by S. mutans. Although our original phenol-sulfuric acid - deoxyribonucleic acid (PSA-DNA) assay proved to be a good method for measuring glucan synthesis from pure cultures of S. mutans,

STATEMENT OF SIGNIFICANT ACCOMPLISHMENTS (Continued)

SCIENTIFIC DEPARTMENT (Continued)

it was a limiting procedure as only a few colonies per plaque sample could be analyzed. As a means of reducing the time needed to run the PSA-DNA analysis, the procedure was modified with the use of C¹⁴-labeled sucrose. The accuracy of this modified procedure was similar to that of the original and the time factor was reduced, but still the number of organisms that could be tested per plaque sample was limited and we could not be sure if the colonies picked were representative of the whole sample.

To overcome the limited number of organisms that could be tested per plaque sample, a new procedure was developed that utilized the complete plaque sample. The plaque sample was diluted and filtered through Millipore filters; the filters were then placed on a selective glucan-synthesizing medium containing C¹⁴-labeled sucrose. After incubation, the organisms and glucans were removed from the filters and the incorporated radioactivity was determined and related to the amount of organisms present as determined by DNA analysis.

Plaque samples were analyzed from 25 caries-free and 25 caries-active recruits. The S. mutans isolated from the caries-active recruits synthesized significantly more insoluble glucan, as well as total glucans, when compared to the S. mutans isolated from caries-free recruits.

| | Caries-Active Recruits (N=25) | Caries-Free Recruits (N=25) | T-test |
|------------------|-------------------------------------|-----------------------------------|--------------|
| | CPM/mg DNA* | | |
| Insoluble glucan | 1666 + 1114 | 1012 + 677 | +40 = 2.51† |
| Soluble glucan | 283 + 393 | 158 + 339 | +48 = 1.38 |
| Total glucans | 1949 + 1180 | 1170 + 783 | +48 = 2.75†† |

*Counts per minute/mg of deoxyribonucleic acid

†Significant - Welch's t-test, p < 0.025

††Significant, t-test, p = < 0.01

These data offer evidence for the first time that the insoluble glucan and total glucan synthesizing ability of S. mutans isolated from the mouths of individuals can be related to the individual's caries activity.

To further demonstrate the role of insoluble glucans in caries activity 14 S. mutans strains that synthesized varying amounts of insoluble glucans were implanted into rats. The following table shows that the 3 strains that were low insoluble glucan producers produced the least amount of dental decay in the animals, whereas the high insoluble producers initiated the greatest

STATEMENT OF SIGNIFICANT ACCOMPLISHMENTS (Continued)

SCIENTIFIC DEPARTMENT (Continued)

amount of decay. The intermediate synthesizing glucan producers produced levels of caries activity between the extremes of the low and high levels of activity. These data offer further evidence of the relationship of insoluble glucans to caries activity particularly smooth surface decay.

Relationship of Insoluble Glucan Synthesis by S. mutans
and Caries Activity in Rats

| Glucan Production | Mg Insol Glucan per Mg DNA | No. Strains | Caries Scores (Mean \pm S.D.) | | |
|-------------------|----------------------------|-------------|---------------------------------|---------------|----------------------|
| | | | Proximal | Bucco-lingual | Total Smooth Surface |
| Low | 42 \pm 20* | 3 | 4 \pm 2° | 12 \pm 9 | 16 \pm 10 |
| Medium | 69 \pm 7† | 5 | 9 \pm 6 | 15 \pm 10 | 24 \pm 16 |
| High | 156 \pm 76*† | 6 | 12 \pm 3° | 18 \pm 11 | 30 \pm 13 |

*Significant - $p < 0.05$

†Significant - $p < 0.05$

°Significant - $p < 0.01$

The enzyme glucosyltransferase (GTF) is responsible for the synthesis of the glucans. Compounds are being tested that will inhibit the enzyme and prevent the synthesis of the glucans. Four compounds were tested for their inhibitory activity against the enzyme. Chlorhexidine and sodium lauryl sulfate at concentrations at 0.1 percent completely inhibited enzyme activity. Thioglycollic acid at 0.04 and 0.1 percent inhibited 15 and 26 percent of the GTF activity respectively. Sodium fluoride at concentrations up to 100 ppm did not inhibit the enzyme.

The role of insoluble glucans in the development of smooth surface decay has been described, but little information is available on methods that will interfere with its synthesis. Experiments were carried out on the effect of a low molecular weight dextran, T-10*, on in vitro glucosyltransferase activity and caries inhibition in rats and hamsters. T-10, in concentrations of 0.01, 0.1, and 1.0 percent was added to [glucose-U-¹⁴C]-sucrose in the presence of S. mutans K1-R glucosyltransferase. The soluble and insoluble glucans formed in 2, 4, 8, and 16 hours were determined. The anti-caries effect of the T-10 was evaluated using weanling Osborne-Mendel derived rats and Golden hamsters. The animals were infected with S. mutans #6715 and maintained on one of two cariogenic diets, each supplemented with either 1 or 15 percent T-10 in the experimental groups or unsupplemented in the controls.

*Pharmacia Fine Chemicals, Piscataway, N.J.

STATEMENT OF SIGNIFICANT ACCOMPLISHMENTS (Continued)

SCIENTIFIC DEPARTMENT (Continued)

The T-10 delayed the in vitro synthesis of insoluble glucans and increased the rate of soluble glucan synthesis. Increasing the concentrations of T-10 prolonged the delay. When 1 percent T-10 was added to diet 2000, containing 56 percent sucrose, there was no reduction in decay in either the rats or hamsters. However, when added to diet 78053, containing 25 percent sucrose, the T-10 reduced caries activity in the hamsters by 88 percent; there was no significant reduction of caries in the rats. When 15 percent T-10 was added to both diets it reduced caries activity 99 percent in the hamsters. Little caries developed in the control rats and the effect of 15 percent T-10 in these animals could not be determined.

Further study is indicated to determine how best to utilize the T-10 as a means of controlling dental caries in Navy and Marine Corps personnel. The low molecular weight dextrans are non-antigenic, non-toxic, tasteless, and could be useful as an additive to cariogenic foods served in Navy messes.

An extensive search for sources of enzymes which can degrade specific oral cariogenic plaque deposits was conducted. The survey of soil, water and sewage samples resulted in the isolation of a number of microorganisms which elicited a true α -1, 3-glucanase. An isolate which produced the greatest amounts of the enzyme was identified as Pseudomonas sp., and was selected for further studies. Production of the enzyme was expanded to multiliter batches. The enzyme was found to be inducible. Purification of the cell-free activity was facilitated by ultrafiltration, freeze-drying, ammonium-sulphate and acetone precipitation, and gel permeation chromatography. The temperature optimum was found to be near 56°C and the optimum pH at 37°C was near 5.0. An analysis of gel permeation separated end products by thin layer chromatography indicated an endohydrolase mechanism of enzyme activity. The enzyme was confirmed to be a true α -1, 3-glucanase by proton N.M.R. and by substrate specificity studies. When the enzyme was applied to Bio Gel A-15 M and Ultrogel AcA34 columns, two distinct peaks of α -1, 3-glucanase activity were resolved. Further purification and characterization studies as well as in vivo hamster experiments are being conducted.

Attempts to synthesize effective caries-preventive agents to further increase the affinity of dextranase for hydroxyapatite are also being explored. Attempts have been made to synthesize two different amino acid carboxyanhydrides as activated coupling agents. The specific carboxyanhydrides were diaminosuccinic acid and diaminopimelic acid; both compounds are potential bifunctional coupling agents. A variety of other coupling reagents are also being tested for potential development as an improved enzymatic caries-preventive delivery method.

The factors responsible for adherence of bacteria to tooth surfaces and methods of interfering with this binding could have a great impact on the prevention of oral disease in naval personnel. Studies related to factors which are capable of interfering with microbial colonization of in vitro surfaces have continued in FY79. Some factors which may be important in the initial adsorption of S. mutans onto hydroxyapatite (HA) disks as well as

STATEMENT OF SIGNIFICANT ACCOMPLISHMENTS (Continued)

SCIENTIFIC DEPARTMENT (Continued)

saliva-coated HA disks have been defined. When the HA surfaces were pre-treated with compounds such as mucin, saliva from caries-free and caries-active naval recruits, phosvitin, and Fusarium dextranase the total quantity of S. mutans cells adsorbed to HA were greatly limited. When the cells were treated with various enzymes, it was discovered that the cell surface had a factor which was susceptible to proteolytic enzymes. Protease treatment of the cells resulted in a greatly reduced ability of S. mutans cultures to adsorb to the HA surfaces. Dextranases and hyaluronidase, did not affect this quantitative initial attachment of the S. mutans strains studied. This result is in agreement with the concept that streptococcal glucans are more often associated with the accumulation of cariogenic microbial plaques. Other evidence also indicates that glucans can influence the strength or degree of streptococcal adherence to the tooth enamel surfaces. By reducing the tenacity of adherence, the total role of oral bacterial colonization might be reversed. The therapeutic prevention of specific cariogenic microbial plaque components by adherence inhibition is of great practical importance for the control of certain oral diseases.

An attempt is underway to eliminate or control dental caries in the mouths of naval personnel with a stannous fluoride gel placed on Super-Floss and applied once to the interproximal space of the teeth. Evidence indicates that in the absence, or the presence of few S. mutans at an interproximal site, no smooth lesions will develop. If the stannous fluoride treatment eliminates or drastically reduces the organism from a particular site, that area should become less prone to caries attack.

To date 16 subjects had all their carious lesions restored; 11 received a fluoride treatment and 5 served as controls-treated with a saline solution.

Prior to fluoride treatment 236 of the 244 (96.7%) sites sampled were infected with S. mutans. The following table shows the data on the effectiveness of the fluoride treatment; it indicates the percentage of sites that became negative for S. mutans and a percentage of the sites that had a reduction of at least 50 percent of their S. mutans, over a specified time period:

The Effect of Stannous Fluoride on the Elimination and Reduction of
S. mutans at Posterior Interproximal Tooth Sites

| Time - Months | No. Patients | Percent of Sites | |
|---------------|--------------|------------------|-----------------|
| | | Reduced to 0% | Reduced 50-100% |
| 1 | 11 | 24.5 | 66 |
| 2-4 | 11 | 21.2 | 57 |
| 4-6 | 11 | 18.7 | 63 |
| 6-8 | 11 | 19.7 | 44 |
| 8-12 | 5 | 1.2 | 78 |

STATEMENT OF SIGNIFICANT ACCOMPLISHMENTS (Continued)

SCIENTIFIC DEPARTMENT (Continued)

At 8 months, the one time application of stannous fluoride completely eliminated S. mutans infections in the plaques at 20 percent of the sites. Eight months after treatment, S. mutans were reduced to less than half the pre-experimental levels in 44 percent of the sites. The control subjects did not vary in the numbers of S. mutans present or the sites infected after receiving saline in place of the fluoride.

Generally the stannous fluoride was most effective against the organisms at the cuspid-premolar areas and least effective around the first molar (1st and 2nd molars; 1st molar; and bicuspid). Data from Captain Wirthlin's study (ZF51524012.0006) on the development of new lesions in young naval personnel indicates that the area around the 1st molar is most susceptible to new decay. There was a reduction of S. mutans around the susceptible area following the administration of fluoride but whether this reduction was large enough to prevent subsequent decay is not yet known. To date only one of the treated patients -- on the program 8 months -- has developed an incipient interproximal lesion on a 2nd molar. He has been referred to his dentist for treatment. None of the other subjects treated or controls have developed an interproximal lesion.

A dietary survey of the subjects indicated that those with initially the highest levels of S. mutans and who maintained high levels of the organisms after fluoride treatment consumed more sweets than the other individuals. The subjects that responded best to the fluoride treatment ate the least amount of sweets.

HONORS, AWARDS, POSITIONS HELD, CEREMONIES, STAFF ARRIVALS,
DEPARTURES AND REENLISTMENTS

NOVEMBER

DT2 M. L. MINTEN advanced to DT1, effective 16 November 1978.

Ms. S. SACK resigned from NDRI, Veterinary Sciences Division.

Mrs. C. BENSON transferred from the Fiscal and Supply Division to the Veterinary Sciences Division.

DECEMBER

A Meritorious Mast was held for DTC G. R. ELLIOTT.

DTC G. R. ELLIOTT departed from NDRI, Great Lakes for the U.S.S. Enterprise (CVN 65), homeported in Alameda, California.

DT3 M. J. EDENFIELD reported aboard for duty from Lab School, NRMC, Oakland, California.

DA R. K. JOHNSON advanced to DN.



DTC G. R. ELLIOTT receiving a Letter of Appreciation
from Captain M. R. Wirthlin.

HONORS, AWARDS, POSITIONS HELD, CEREMONIES, STAFF ARRIVALS, DEPARTURES,
AND REENLISTMENTS (Continued)

JANUARY

Good Conduct Awards were presented to the following staff personnel:

DT2 G. L. BAILEY
DT1 J. M. MC CORMICK
DT2 S. L. ORR
DT2 N. A. WASDIN

CDR E. B. HANCOCK was appointed as Consultant, graduate periodontics,
Indiana University, School of Dentistry, Indianapolis, Indiana.

Dr. L. G. SIMONSON and Dr. B. L. LAMBERTS submitted a patent disclosure
to ONR, Chicago entitled "Method for Producing α -1, 3-glucanase."

FEBRUARY

LT L. D. NELSON, Administrative Officer was frocked as Lieutenant
Commander.

Mrs. V. L. BALLANTINI received a 20 year pin and certificate of government
service.

HM2 J. CAMACHO departed on 31 days terminal leave to expire on 29
March 1979; discharged from Naval Station, Brooklyn, New York.

Dr. L. G. SIMONSON received an Outstanding Performance Award.

MARCH

Dr. I. L. SHKLAIR was re-elected Program Chairman IADR/AADR,
Microbiology Division.

Dr. L. G. SIMONSON and Dr. B. L. LAMBERTS were assigned U.S. Patent
#4,138,476 "Plaque Dispersing Enzymes as Oral Therapeutic
Agents by Molecular Alteration."

APRIL

HM1 E. W. LARSON reported aboard for duty from the Naval Regional Medical
Center, Okinawa.

DT1 W. V. REESE was nominated NDRI's "Sailor of the Year."

DT3 M. J. EDENFIELD received a Letter of Appreciation.

Ms. M. J. ROUSE received a Quality Step Increase.

Dr. B. L. LAMBERTS and Dr. L. G. SIMONSON received a patent award
for \$150.00 each.

HONORS, AWARDS, POSITIONS HELD, CEREMONIES, STAFF ARRIVALS, DEPARTURES,
AND REENLISTMENTS (Continued)

APRIL (Continued)

LT J. W. GALICH received a certificate of completion for "Fleet and Marine Support Operational Management Seminar" from the National Naval Dental Center, Bethesda, Maryland.

LT L. D. NELSON was promoted to Lieutenant Commander, effective 16 April 1979.



DTI W. V. REESE taking the oath for re-enlistment from CDR E. P. Leonard. DTI W. V. REESE was also nominated NDRI's "Sailor of the Year."

MAY

Dr. L. G. SIMONSON received 2nd place in the Young Investigators Award competition, Chicago Section, American Association for Dental Research.

Dr. B. L. LAMBERTS completed term as President of the Chicago Section IADR/AADR.

Ms. M. EDWARDS was hired as Clerk/Stenographer in the Administrative Division.

LT J. W. GALICH was transferred to the USS Guadalcanal.

HONORS, AWARDS, POSITIONS HELD, CEREMONIES, STAFF ARRIVALS, DEPARTURES,
AND REENLISTMENTS (Continued)

JUNE

CDR G. E. CLARK was frocked as Captain.

CDR E. P. LEONARD was selected for Captain.

CDR E. B. HANCOCK was selected for Captain.

Mrs. T. GRISHMAN, Clerk/Stenographer, Administrative Division resigned;
receiving a Sustained Superior Performance Award.

LT J. C. MEIERS, DC, USN reported to NDRI for duty in the Research
Postdoctoral Fellowship Program from U. S. Naval Station, Keflavik,
Iceland.

JULY

LT J. PECOTTE, DC, USN was discharged from active duty, to postdoctoral
training in pedodontics.

Dr. L. G. SIMONSON was selected for inclusion in "American Men and
Women of Science."

LT F. AKER III reported aboard NDRI for duty from the Naval Regional
Dental Center, Long Beach, California.

CDR R. G. WALTER reported aboard NDRI for duty from the 3rd Force
Service Support, Fleet Marine Force, Okinawa, Japan.

Mr. K. E. KUETER was hired as an Animal Caretaker in the Veterinary
Sciences Division.

AUGUST

DT1 W. V. REESE re-enlisted.

LCDR R. W. GAUGLER was promoted to Commander.

Mrs. V. L. BALLANTINI received a Sustained Superior Performance
Award.

SEPTEMBER

DT3 M. J. EDENFIELD was promoted to DT2.

HONORS, AWARDS, POSITIONS HELD, CEREMONIES, STAFF ARRIVALS, DEPARTURES,
AND REENLISTMENTS (Continued)

SEPTEMBER (Continued)

CDR R. G. WALTER received the Navy Commendation Medal for meritorious service with the Third Marine Division.

The staff of the Naval Dental Research Institute toured the USS O. H. Perry (FFG 7) at Navy Pier in Chicago, Illinois.

NDRI received accreditation from the Academy of General Dentistry "authorizing NDRI to grant credit for attendance at NDRI lectures and seminars."



CDR R. G. WALTER receiving the Navy Commendation Medal from Captain M. R. Wirthlin.

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