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Thanks From Our Leadership

One of the frequently voiced complaints that I hear on my visits to our Medical Department facilities is that "our Navy does not appreciate what we do." Believe me, this not true. I will admit, however, that all too frequently their words and expressions of appreciation and approval fail to get down to the outstanding men and women of our Medical Department who provide the services and support of which we can be so proud.

Recently VADM Lewis H. Seaton received a letter from ADM James D. Watkins, Chief of Naval Operations, portions of which are quoted here: "The outstanding performance of our Navy Medical Department units has been highly evident in the recent past . . . following destruction of most medical capability ashore in wake of terrorist bombing at Beirut Airport, surviving Dental Corps officers immediately formed triage teams . . . treatment from offshore units, aboard USS *Iwo Jima* and in-theater support at Naples, Rota, and Sigonella all superb . . . Long Commission specifically cited expert medical care . . . concurrent no-warning requirement to support Grenada ops met with same high levels of professional response . . . changes had been initiated last year to improve operations by our Medical Departments . . . I am pleased with progress made to date . . . proper medical care for our entire Navy family is a number one priority . . . your interest and positive support remain essential for our efforts to achieve full potential."

ADM Watkins is not alone in his expression of recognition and appreciation of Medical Department efforts. Almost daily I receive letters and calls from our senior leadership complimenting and recognizing the superb support you are providing their personnel and their families. These testimonials recognize the limitations in personnel and fiscal resources with which we must all contend. But more than anything else, they recognize the professionalism which has become a hallmark of your performance. Keep it up. You well deserve the Navy's "Thank you."

William M. McDermott, Jr.
RADM, MC, USN

New Commodore Selectees

The Navy Medical Department has four new commodore selectees, three from the Medical Corps and one from the Dental Corps.

Commodore-selectee **Robert Paul Caudill,** MC, Commander, Naval Medical Command, European Region, was born in Louisville, KY, on 8 Nov 1936. He graduated from Wake Forest College in Winston-Salem, NC. As a commissioned participant in the Ensign 1915 Program, CAPT Caudill attended the University of Tennessee College of Medicine, graduating with an M.D. degree in 1963. He holds a master's degree in public health administration from Tulane University and a master's degree in administration and management from George Washington University. He is also a graduate of the Industrial College of the Armed Forces in Washington, DC.

Dr. Caudill entered active naval service as an intern at the Naval Hospital, St. Albans, NY, and after completing his internship, he served at the Naval Shipyard, Brooklyn, NY, and aboard USS *Compass Island* (EAG-153) until ordered to the School of Aviation Medicine in Pensacola, FL, where he was designated a naval flight surgeon.

Subsequent tours of duty included Naval Auxiliary Air Station and VT-22, Kingsville, TX; Naval Air Station, Whiting Field, Milton, FL; Senior Medical Officer and Head of the Medical Department aboard USS *Ticonderoga* (CVA-14), USS *Bon Homme Richard* (CVA-31), and USS *Nimitz* (CVN-68) precommissioning unit. His staff duty assignments have included Assistant Force Medical Officer, Commander, Naval Air Force, U.S. Pacific Fleet; Force Medical Officer, Commander, Naval Air Force, U.S.

CAPT Caudill

Atlantic Fleet; and Fleet Medical Officer, Commander, U.S. Naval Forces, Europe. He served as Commanding Officer, Naval Aerospace Medical Institute; Director of Clinical Services, Naval Regional Medical Center, San Diego, and Executive Officer, Naval Hospital, San Diego.

After completing the Navy residency in aerospace medicine in 1973, CAPT Caudill received the Aerospace Medical Association's Julian E. Ward Memorial Award, sponsored by the Air Force, for outstanding performance as a resident in aerospace medicine. He is a diplomate of the American Board of Preventive Medicine. His military awards include the Legion of Merit, Meritorious Service Medal, Navy Commendation Medal, Air Force Commendation Medal, Navy Achievement Medal, and a number of unit and campaign awards.

Commodore-selectee **Robert W. Koch,** DC, Director, Direct Dental Care Division, Naval Medical Command, Washington, DC, was born 14 Sept 1934 in St. Louis, MO.

Dr. Koch received his D.M.D. degree from Washington University, St. Louis in 1959. He also holds a master's degree in education from George Washington University, Washington, DC. He served an internship at Portsmouth, VA, from 1959 to 1960, and later completed his residency in periodontics at the Naval Dental School, Bethesda, MD.

Following his internship CAPT Koch served aboard USS *Cadmus* (AR-14) until 1962, when he was assigned to Naval Hospital, Great Lakes, IL. He returned to St. Louis for several years as an assistant professor in oral medicine at Washington University School of Dentistry, where he established and served as the Commanding Officer of the Dental Student Reserve Program. In 1966 Dr. Koch returned to active duty at the Naval Dental Clinic, Naval Amphibious Base, Little Creek, VA. From

CAPT Koch

1967 to 1969 he served as the Senior Dental Officer, USS *Wright* (CC-2), the command ship for the President of the United States and the Joint Chiefs of Staff.

CAPT Koch practiced periodontics at the Naval Dental Clinic, Washington, DC, and the Naval Dental School, Bethesda, MD, where he later served as Chairman and Program Director of the Graduate Training Program in Periodontics. From 1977 to 1980 he was assigned to the Professional Branch, Dental Division, Bureau of Medicine and Surgery, as the Head of Dental Standards. Dr. Koch took command of the Naval Regional Dental Center, Charleston, SC, in 1980 and was assigned as Director, Direct Dental Care Division, Naval Medical Command, Washington, DC, in 1983.

Dr. Koch is a member of the American Dental Association, the Greater Washington Society of Periodontology, the American Association of Dental Schools, the Association of Military Surgeons of the United States, and the Interagency Institute for Federal Health Care Executives. He is Vice President of the American Academy of Periodontology and will serve as President in 1986. Dr. Koch is certified as a diplomate of the American Board of Periodontology and is a fellow in the International College of Dentists. His military awards include the Meritorious Service Medal with Gold Star in lieu of second award, Navy Commendation Medal, and National Defense Medal.

Commodore-selectee **James T. Sears,** MC, Commanding Officer of Naval Hospital, Oakland, CA, was born in Minoa, NY, on 19 April 1937. He graduated from Wesleyan University in Middletown, CT, and received a medical doctorate from Albany Medical College of Union University in 1963. He served a rotating internship at Albany Medical Center Hospital, was commissioned in the Navy in 1964, and completed his psychiatric residency at the National Naval Medical Center, Bethesda, MD, where he was chief resident from 1966 to 1967.

CAPT Sears

Subsequent military assignments have been as staff psychiatrist at Philadelphia Naval Hospital (1967); Head of the Neuropsychiatry Branch aboard USS *Repose* (AH-16) in Vietnam service (1967-68); Head of the Officers' Unit (1969-71), and later (1971-73), Assistant Chief and Director of Residency Training, Neuropsychiatry Service, at Philadelphia Naval Hospital; and Chairman of the Department of Psychiatry at Naval Regional Medical Center, Portsmouth, VA, (1976-79) where he established the Psychiatry Residency Program, and transferred to assume the same position at Naval Regional Medical Center, San Diego, CA, (1979-82). He also established the Psychiatry Residency Program at that institution. In 1982 he was appointed Director of Clinical Services at Naval Regional Medical Center, Oakland, CA, and assumed command of the recommissioned Naval Hospital, Oakland on 3 June 1983.

Dr. Sears has been consultant to penal institutions, team member for the homecoming of prisoners of war held in Vietnam, consultant for the Navy's Antarctic Support Force, psychiatric consultant to the Surgeon General, examiner for the American Board of Psychiatry, and a member of the interagency medical team for American hostages held in Iran.

CAPT Sears' academic appointments have included Eastern Virginia Medical School, Hahnemann Medical College, and the University of Pennsylvania. He holds the position of Adjunct Professor at the United States International University, and Associate Clinical Professor at the University of California, San Diego School of Medicine. He is a member of 10 professional organizations, has been certified by the American Board of Psychiatry and Neurology since 1971, is a diplomate of the National Board of Medical Examiners, and is a fellow of the American Psychiatric Association.

In addition to the Meritorious Service Medal with Gold Star and the Navy Commendation Medal with Gold Star, CAPT Sears wears the Navy Unit Commendation, National Defense Service Medal, Antarctic Service Medal, Vietnam Service Medal, Republic of Vietnam Civil Action Medal, Republic of Vietnam Gallantry Cross with Palm, and Republic of Vietnam Campaign Medal.

Commodore-selectee **James K. Summitt,** MC, Commanding Officer of Naval Hospital, Oakland, CA, began his career as a naval aviation cadet in 1954. Upon completion of advanced flight training at NAS Hutchinson, KS, he received his commission and was designated a naval aviator. From 1956 to 1959 he was assigned to Patrol Squadron Two (VP-2), NAS Whidbey Island, WA, where, among many duties, he served as Patrol Plan Commander in P2V-7 aircraft.

CAPT Summitt was released from active duty in June 1959 but continued to serve as a member of the Ready Reserve while earning a B.S. degree from Harding College, Searcy, AK, in 1960 and an M.D. from the University of Tennessee in 1963. Dr. Summitt returned to active duty as an intern at the Naval Hospital, Oakland in 1964-65. Following his internship he graduated from the Naval School of Submarine Medicine, served a tour aboard USS *Casimir Pulaski* (SSBN-633), took a year of graduate training in diving physiology at the University of Pennsylvania, had a short tour with the Military Operations Division of Diving Research at the Submarine Base New London, and served over 3 years as Senior Medical Officer at the Navy Experimental Diving Unit, Washington, DC. During this period he completed qualifications for and was designated a qualified submarine officer and a saturation diving medical officer.

In 1971 Dr. Summitt returned to clinical medicine as an ophthalmology resident at the Naval Regional Medical Center, San Diego. Upon completion of his training in 1974, he remained on the ophthalmology teaching staff in San Diego and assumed the position of Assistant Chairman of Ophthalmology in 1976. He was named Chairman of Ophthalmology in September 1977. He assumed command of the Naval Submarine Medical Center, Groton, CT, in 1980, and in 1983 became Commanding Officer of Naval Hospital, Camp Pendleton, CA.

Dr. Summitt is a diplomate of the American Board of Ophthalmology, a member of the American Academy of Ophthalmology, a member of the Association of Military Surgeons of the United States, and is a member of several other professional organizations. He has served for 2 years as the official consultant to the Surgeon General for ophthalmology. In addition to the Legion of Merit, CAPT Summitt's decorations include a Meritorious Service Medal with Gold Star, two Meritorious Unit Citations, and the National Defense Ribbon. □

CAPT Summitt

Full-Time Outservice Position for Trauma Fellowship

A Navy-sponsored full-time outservice fellowship in Trauma Management is being established at Tulane University Medical Center, under the direction of Norman E. McSwain, M.D., F.A.C.S.

• The program has three phases:
  (1) Operative experience as a teaching assistant
  (2) Research (clinical or bench)
  (3) Pre-hospital care

• The major thrust of the fellowship will be learning to manage trauma, particularly penetrating trauma, by study, literature review, research, and practical experience. All phases will be addressed, including prehospital operative management, postoperative recovery, and the handling of complications.

• Board eligibility in general surgery is a prerequisite. Candidates chosen by the Graduate Medical Education Selection Board are subject to review by the Tulane Department of Surgery. This review will be based on the curriculum vitae, letters of recommendation, and, possibly, an interview.

Applicants should submit a NAVMED 1520/11, Application for Graduate Medical Education, in accordance with BUMEDINST 1520.10H and NAVMEDCOMNOTE 1520 no later than 1 July 1984 to: Naval Health Sciences Education and Training Command, Naval Medical Command, National Capital Region, Bethesda, MD 20814.

Independent Duty in Seoul

Being independent means different things to different people. Although one man sees independence as being without commitment, without ties; another man may see it as being able to choose his own job, his own responsibilities, his own lifestyle.

In essence, that is the same position HM1 Michael C. Mangoian accepted when he took the independent duty assignment in Seoul, Korea. Mangoian, who earlier in life had studied for a career in the priesthood, has been in the Navy over 15 years. He has served 28 months of a 3-year Korean tour on independent duty as a Medical Department representative.

Mangoian's patients include about 275 U.S. Navy and Marine Corps personnel, including U.S. Marine security guards from the U.S. Embassy, members of the United Nations Command (UNC)—Australians, Canadians, and Gurkhas and Scots of the UNC Honor Guard—and British personnel from the Commonwealth Liaison Mission.

"I treat only active duty personnel," Mangoian points out. "However, even though I see between 10 to 40 people a day, I still make rounds at the Army hospital every afternoon, checking on both active duty and their dependents there. And of course I'm on call 24 hours a day."

Mangoian, realizing the importance and responsibility the Navy has bestowed upon him by appointing him to this position, is quick to point out that if at any time he feels he cannot treat someone, he will refer the patient to the appropriate clinic. "One time I diagnosed pink eye, a highly contagious condition, and suggested the patient go to the EENT clinic, which of course he did."

Mangoian treats patients for minor maladies and offers assistance to those patients who come under his authority but need hospitalization. He has tended a patient with a fractured hip, another with a surgically amputated left toe, one with facial lacerations, and still another who underwent surgery for kidney stones.

Schools that have led Mangoian to the position he now holds include the 16-week Hospital Corps "A" School, where he learned anatomy and physiology, first aid and emergency procedures, nursing procedures, food in health and disease, prevention and control of disease, basic pharmacology and review of toxicology, pharmacy, and NBC warfare.

He also attended the Urology Technique "C" School for 6 months, learning basic operating room technique, anatomy and physiology, X-ray technique, basic lab technique and urological procedures, and the 5-week Field Medical Service School. Mangoian is also a licensed Vocational Nurse in California.

Welcoming his assignment to Korea, Mangoian says it's probably one of the best kept secrets in the Navy. "Even though I'm actually in Seoul, these 3 years are considered sea duty. And it's great having this kind of responsibility." He answers to the Commander, U.S. Naval Forces, Korea for administration purposes and to the CINCPACFLT (Commander-in-Chief, Pacific Fleet) surgeon for medical matters.

HM1 Mangoian examines a Marine's throat.

As the Medical Department representative and "independent duty hospital corpsman," Mangoian maintains custody of all Naval Forces (USN/USMC) health and dental records for those assigned in the Seoul area; holds sick call for Naval Forces personnel, which includes diagnosing, prescribing medication, treatment, and followup care; writes consultations to Army doctors at the U.S. Army hospital when the specific situation dictates; orders routine lab and x-ray studies; performs minor surgical procedures such as cleaning and suturing wounds; and keeps the commander, U.S. Naval Forces, Korea informed on a daily basis of the health status of Naval Forces personnel.

"I have to maintain a good working rapport with the Army staff here, too," Mangoian explains. He is the only Navy medical representative in an all-Army health clinic. "I could refer most of my patients to the Army specialists if I wanted to, but I prefer handling my own people myself," he insists. "I'd say I spare the Army doctors from having to see 250 to 300 patients per month."

There are times he gets bogged down with paperwork—"the administrative side of the job," he says, "but health care is first and foremost in my mind. It's the people I care about, and independent duty here is giving me the perfect opportunity to do what I do best." □

—Story and photos by SSGT Cindi Small, USA

U.S. Navy Medicine inaugurates a new series this issue, "Hey Doc," designed to stimulate discussion and contribute to the continuing medical education of our readers.

Hypoxia

1. Hypoxia is a condition characterized by an inadequate or unusable amount of oxygen provided to tissues. Match the four categories of hypoxia listed below with their causes.

(1) Histotoxic	(A) Carbon monoxide poisoning
(2) Anemic	(B) Decreased hemoglobin saturation
(3) Stagnant	(C) Cyanide poisoning
(4) Hypoxic	(D) Decreased effective blood pressure

Answer: (1) C (2) A (3) D (4) B

Histotoxic hypoxia occurs when the tissues become unable to utilize the oxygen which is delivered to them even though this supply might be adequate under normal conditions. The classic example of a histotoxin is cyanide because it prevents utilization of oxygen by the electron transport system, thereby curtailing energy production.

Anemic hypoxia is seen when either the amount of hemoglobin is reduced as in anemia (a quantitative reduction) or it is rendered ineffective as in carbon monoxide poisoning (a qualitative reduction).

Stagnant hypoxia is caused by a reduction in effective blood pressure which is evident in vascular occlusion or, more commonly, from the venous pooling experienced by the jet pilot performing a high-G turn. Blood oxygen content and hemoglobin content/saturation are normal in stagnant hypoxia.

Hypoxic hypoxia is characterized by a decreased amount of oxygen presented to the blood yielding a diminished hemoglobin saturation.

2. The oxyhemoglobin dissociation curve describes the relationship between the percent of hemoglobin saturation and the partial pressure of oxygen in the blood. Acidosis, elevated partial pressure of carbon monoxide, and elevated temperature all shift the curve to the right which means:

(A) Oxygen is delivered to the tissues at a lower partial pressure, thereby enhancing tissue oxygenation.

(B) Oxygen is delivered to the tissues at a higher partial pressure, thereby enhancing tissue oxygenation.

(C) Oxygen is delivered to the tissues at a lower partial pressure, thereby diminishing tissue oxygenation.

(D) Oxygen is delivered to the tissues at a higher partial pressure, thereby diminishing tissue oxygenation.

Answer: B

When the oxyhemoglobin dissociation curve is shifted to the right, any given percent hemoglobin saturation equates to a *higher* oxygen partial pressure. Thus, when hemoglobin circulates normally at 98 percent saturation, the tissues receive a higher partial pressure of oxygen under any of the three conditions listed above. Conversely, under conditions of hypothermia, alkalosis, or lowered partial pressure of carbon dioxide, the same 98 percent saturated hemoglobin will deliver less effective oxygen to the tissues. Interestingly, carbon monoxide shifts the curve to the left and flattens it slightly.

3. True or False: Oxygen delivery to the myocardium can be enhanced by increasing the percent of oxygen extracted from the blood as it passes through the coronary arteries.

Answer: False

The oxygen content of coronary sinus venous blood is 4 mg percent and, compared with the 14 mg percent supplied to the coronary arteries, represents maximal oxygen extraction as the blood passes through the coronary arteries. The only effective means to increase oxygen delivery to the myocardium is to increase coronary blood flow by increasing cardiac output (perhaps increasing oxygen demand as well) or by coronary artery dilation.

4. Cyanosis is a relatively poor indicator of hypoxia for all of the following reasons except:

(A) Cyanosis is difficult to appreciate in dark-skinned people.

(B) Serious effects of hypoxia may develop before cyanosis is evident in a person who is anemic.

(C) Cyanosis does not develop in the presence of methemoglobin or sulfhemoglobin.

(D) Cyanosis is not evident until at least 5 mg percent hemoglobin is unsaturated.

Answer: C

The classic blue color of cyanosis is only evident when the amount of unsaturated hemoglobin reaches 5 mg percent. In the anemic person, where 5 mg percent might represent a significant decrement in functional hemoglobin, symptomatic hypoxia may occur long before cyanosis develops. Conversely, in the polycythemic individual, 5 mg percent unsaturated hemoglobin might not represent a significant loss of blood oxygen content. Cyanosis may also be present with as little as 0.5 mg percent sulfhemoglobin or 1.5 mg percent methemoglobin. Cyanosis is, therefore, not always a reliable indicator of hypoxia.

5. The tracheal partial pressure of oxygen while breathing air at sea level is ____?____ the tracheal partial pressure of oxygen while breathing 100 percent oxygen at an altitude of 33,000 feet.

(A) Equal to (B) Greater than (C) Less than

Answer: A

The tracheal partial pressure of oxygen while breathing air at sea level is 150 mmHg ([760 mmHg atmospheric pressure—47 mmHg constant water vapor pressure] x .21 oxygen fraction) which is equal to the tracheal partial pressure of oxygen at 33,000 feet while breathing 100 percent oxygen (197 mmHg—47 mmHg). Likewise, breathing air at 10,000 feet is approximately equivalent to breathing 100 percent oxygen at an altitude of 39,000 feet. This demonstrates the concept of equivalent altitudes.

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Leadership and Management

LCDR James M. LaRocco, MSC, USN

Management training has long been an integral part of the Navy Medical Department's education efforts. Courses such as Executive Medicine for officers and Human Resources Management for chief petty officers have provided excellent introductions to general management theory and practice.

Over the years, however, it has become apparent that these courses have failed to provide an adequate understanding of what is actually done to manage successfully a hospital division or department, or to command an entire hospital. Such inadequacies have been reflected in the criticism the Medical Department has received for its management practices in general and the management of health care facilities in particular.

Clearly, courses in general management theory simply do not provide the kind of information necessary to increase the effectiveness of military personnel running a hospital or other health care facility. Most management courses lack an emphasis on leadership, and they fail to identify what skills and behaviors lead to effective performance. In addition, management courses available to Medical Department personnel have not been integrated and coordinated for the programmatic development of leadership and management skills.

The purpose of the new Leadership and Management Education and Training (LMET) program is to increase the overall level of leadership and managerial effectiveness and to create an integrated leadership and management development system that links training and experience with career development opportunities. This goal is to be achieved in two steps.

A series of LMET courses emphasizing leadership and management skills and behaviors relevant to specific management positions will be given at critical career points. The first such career point will be Officer Indoctrination School (OIS), where LMET is already part of the introductory courses. Following this introductory LMET course, there will be courses for division officers, department heads, and prospective commanding/executive officers. Existing LMET courses for enlisted personnel include a course for leading petty officers (LPO) and one for leading chief petty officers (LCPO).

The second step is the development of a program that ties together training, career development models, and billet requirements. This will require a review of all billets to determine training needs, reassessment of current career path models, and an improved method of matching qualified individuals and specific billets.

LMET's History

The Chief of Naval Operations mandated LMET for the line community for many of the same reasons that we are now instituting it in the Medical Department. In 1976 at least 127 distinct leadership or management courses were available. This large number of independent courses caused some concern. Moreover, the effectiveness of some of the courses was questionable, and the purpose they served was often ambiguous. Thus, a need emerged to identify a programmatic effort that would provide a common base of knowledge and that could really improve the leadership and management capabilities of naval personnel. Consequently, a request for proposals was distributed seeking experts' ideas on developing such a program.

McBer and Company, a Boston-based consulting firm founded by Harvard psychologist David C. McClelland, submitted the proposal that was ultimately accepted. This proposal differed from the others in that it offered to (1) identify leadership and management behaviors that distinguish outstanding from average performers, and (2) teach those behaviors, rather than general management theory.

Competency-based training is radically different because it does not assume that one set of management behaviors can be applied to all organizations, since organizations vary sig-

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nificantly in their organizational culture. In fact, it assumes that competencies (effective behaviors) differ not only from organization to organization, but also from level to level within an organization. Each organization and each level therefore requires its own competency model—set of behaviors and skills that distinguish outstanding from average performers within a given job category. Table 1 outlines the competency-based approach—the philosophy behind LMET.

Since the initiation of LMET in 1976, competency models have been developed for leading petty officers, leading chief petty officers, division officers, department heads, and commanding/executive officers. In addition, job-specific courses based on source-school-instructor competency models are now taught to prospective Naval Academy, Officer Candidate School, and NROTC instructors, as well as to recruit company commanders. Most recently, job-specific models have served as the basis for training students in the Supply Corps division officers and department head courses. Finally, a customized version of the fleet division officer model has served as the basis for the Officer Indoctrination School LMET course.

In September 1982, Admiral Small, then Vice Chief of Naval Operations, delivered the following charge:

> The Surgeon General will establish procedures whereby members of the Medical Department who desire and are selected to specialize in hospital and health care management will be provided special training to enhance their career progression in this field. Since leadership and management are a requisite for all officer billets, we will establish a requirement for LMET at an appropriate point in the career of all Medical Department officers.

In January 1983 the Director of Naval Medicine, the Deputy Director of Naval Medicine, and the Commander, Naval Medical Command met with the LMET program sponsor (OP-152) and representatives from McBer and Company to review a proposal to develop a Medical Department LMET program. Shortly after that briefing the go-ahead was given, a program manager was assigned, and the first step was taken to

TABLE 1. Philosophy Behind the Medical Department's LMET Program

I. Training and development for job assignment and promotion should be based on the competencies required for outstanding performance in current and future jobs. This philosophy is based on the following premises:

A. Outstanding leaders/managers behave differently from average or poor leaders/managers

B. The distinguishing effective behaviors (competencies) of outstanding leaders/managers can be identified

C. Once identified, these competencies can be:
1. Taught, formally and informally
2. Assessed in individuals—so that their job placement can be based on *demonstrated* current or potential competence

II. Selection for competence improves the decisions made in:

A. Selection

B. Job assignment

C. Promotion

D. Career pathing

III. By improving the decisions made in selection, job assignment, promotion, and career pathing, the Medical Department will *increase the effectiveness of its leaders and managers* resulting in:

A. Increased commitment to the department—and the Navy

B. Reduced turnover

C. Increased productivity

develop a competency model for commanding officers of health care facilities.

Development of Competency Models

The competency approach leads to a unique type of leadership and management development program. Competency-based courses, unlike Executive Medicine and other general theory courses, are tailored to the needs of specific organization and emphasize skills and behaviors that distinguish outstanding from average performers in a specific kind of job (such as commanding officer of a health care facility). Similarly, a competency-based management development system, one that trains and selects for competence, is tailored to the organization and its needs, rather than trying to fit the organization to a preconceived notion of a "proper" system. To achieve this tailoring of courses and systems, the competency models must first be developed.

Table 2 outlines the development of a competency model and its applications. This research procedure has been followed in developing a LMET course model for senior officers. In this case there were three expert panels, each meeting for half a day with McBer representatives. Two of the panels consisted of Medical Department flag officers. The flag officer panels discussed career development issues and provided their perspective on the skills and characteristics that outstanding commanding officers must possess. The commanding officer panel also discussed these skills and characteristics, but spent most of its time identifying the tasks a CO must perform. In addition, members of all three panels received a list of current and recent CO's and were asked to check the names of individuals whose performance they were familiar with and to identify, among the names they had checked, the clearly outstanding performers.

On the basis of the panel discussions, inventories of CO job tasks and performance characteristics were constructed. These inventories, along with the list of CO's (the "peer-nomination form"), were mailed to all Medical Department CO's. The recipients were asked to rank the tasks and characteristics, and to indicate which CO's they knew and which they considered outstanding. The results will be used to develop the content portion of the senior officer course. The results of the peer-nomination forms were used to select a sample of outstanding and average performers for interviewing by the McBer consultants to gather data for the CO competency model.

The consultants used a special method of interviewing called the Behavioral Event Interview (BEI). In the BEI, the interviewee is asked to think of and then describe specific job-related incidents in which he or she performed effectively and those in which he or she performed ineffectively. The interviewer asks the interviewee to provide concrete details about what he/she thought about and did during these incidents. (The interviewer is not told whether the interviewee has been nominated as outstanding or as average.) The interviews are then tape-recorded and transcribed.

McBer analyzed the interviews. First, several job-competence specialists each read half the transcripts and independently coded them for potential competencies—demonstrations of effective performance. (The interview readers did not know which interviewees had been peer-nominated as outstanding.) For example, a transcript might include a statement by an interviewee such as "I felt it was

TABLE 2. A Competency Model: Development and Applications

I. Development

A. Expert panels provide data on:
1. Individual and unit effectiveness measures
2. Career paths to management billets
3. Skills needed for effective leadership and management
4. When/where/how these skills are learned

B. Interviews with top performers provide data on behaviors that distinguish the most effective leaders/managers

C. Analysis and validation of the above data provide a documented description of the *skills* that are needed for effective leadership and management

II. Applications

A. Career paths

B. Assessment instruments

C. Selection criteria

D. LMET course content

E. Management development resources

important to keep my people informed of the changes, so I held meetings once a week with each department to answer questions on the reorganization." One reader might code this as "provides feedback," another "concern for morale," and a third as "communication."

After this individual coding, the readers met to review their findings to determine behavioral patterns that indicated competencies, to resolve differences in interpretation, and to draw up a hypothesized set of competencies. The transcripts and the list of competencies were than given to another group of readers, who were instructed to code them for *the hypothesized set of competencies*. Unlike the first group of readers, who are key McBer job-competence specialists, those in the second group are trained simply to code. (These people, too, were not told which interviewees were considered outstanding.)

After this second coding, the interviewees' nominations by their peers were revealed (whether as outstanding or as average), and the coding of the interviews was examined to see which competencies were characteristics of the outstanding performers. This model was then cross-validated: the coders were given the unread half of the interview transcripts and asked to code them against the model in order to determine, on a separate sample, whether these competencies were valid, i.e., distinguish the outstanding from the average performers. (The coders did not know which these were before reading the transcripts.) Only those competencies that cross-validated were kept for the final model.

The final competency model for the senior officer course is based on BEI's with 31 commanding officers of health care facilities. This number represents about a third of all the Medical Department CO's and about 40 percent of the health care facility CO's.

A similar effort will be made in FY85 to develop competency models and then courses for Medical Department division officers and charge nurses, and for department heads and chiefs of service. As with such courses as the OIS, PLO, and LCPO, these LMET courses will focus on the skills and behaviors that distinguish outstanding from average performers. In addition, as part of its overall management development system, the Medical Department has programs underway or being considered for executive development of flag officers, selective executive development of high potential mid-career personnel, and selective training for senior staff positions in contingency planning, logistics, and supply.

The implication of these various, more specialized, courses is that not everyone should receive the same management training. Whereas the basic courses are aimed at increasing managerial effectiveness, these latter courses will use competency-based assessment for the selective identification and development of highly competent individuals who have a demonstrated ability for executive medicine.

The effect of this competency-based system will be that those individuals who are most suited to remain in clinical or technical specialties will be identified as such and will do so, while those clinicians and other professionals who are well suited for management positions will be identified and groomed for roles as health care executives. Ideally, each individual will hold a job that best uses his or her talents. The beneficiary will be the Medical Department, whose management will be strengthened by capable, trained leaders. □

USS *Norton Sound* Reunion

The USS *Norton Sound* (AV-11/AVM-1) Association will sponsor its 13th Annual Reunion 18-22 July 1984 at Port Hueneme, CA.

All interested Association members, current and former Norton Sounders, members of attached military units, civil service, and contractor personnel who have served aboard during any period of her 40 years history of service to the Nation are invited to attend.

For more information contact: Robert Hovestadt (805) 485-6144, Clyde Taylor (805) 642-1413, or USS *Norton Sound* Association, P.O. Box 487, Port Hueneme, CA 93041.

Nurses With a Difference

They give round-the-clock attention, support, comfort, and love to patients too young and too sick to show their gratitude. This is the responsibility of the nurses in the neonatal intensive care nursery (ICN) at Naval Hospital, Bethesda.

The 13 military and civilian registered nurses offer direct care and attention to the infants during their hourly routine of administering medication, feedings, and checking vital signs. They also interpret physicians' orders and maintain computerized records of all changes and activities involving each infant.

"It takes a very strong and conscientious person to be an ICN nurse," according to Joe Ann Davidson, charge nurse of the unit. "You learn to handle an assortment of situations and problems all at the same time."

Most of the infants cared for are of a low-birth weight (under 1.5 lbs). Conditions range from guarded to critically ill with the length of stay differing from 2 weeks to 9 months.

The neonatal ICN is a level 3 nursery. It provides the entire spectrum of medical and surgical services for critically ill newborns, including mechanical ventilation, surgery, or other complex procedures.(*1*) This level of care requires the attention of a highly specialized team of physicians, nurses, and technicians.

Physician staff of the 12-bed facility includes two staff neonatologists, four neonatology fellows, one resident, and one to two junior residents.

The biggest problem is the insufficient number of qualified nursing personnel. Although 22 billets exist, the staff is slightly over half that size. This situation necessitates extended hours. Twelve-hour shifts are not uncommon and a phone call during the night requesting help is a familiar occurrence.

Despite the staff shortage, the amount of experience required is not compromised. Nurses must have a minimum of 2 years' experience in a level 2 nursery. This type of facility handles complicated pregnancies and neonatal illness.(*2*) At the Naval Hospital, Bethesda the average is 4 years' experience in such a nursery.

The nurses constantly alter their schedules to accommodate unexpected events. In a sense, there is no daily routine; they are always on the alert. At the sound of the red delivery room phone, each knows exactly what is needed to ready the equipment for the new admission. They efficiently execute the preparation of the respirator, heart monitor, IV's, and warmer, all the while hoping for a false alarm.

In addition to their medical skills, the nurses must be proficient in social services, know how to assist doctors in explaining conditions and evaluations of each infant to the parents, and educate the parents regarding their child's records, teaching them how to recognize changes in the child's condition.

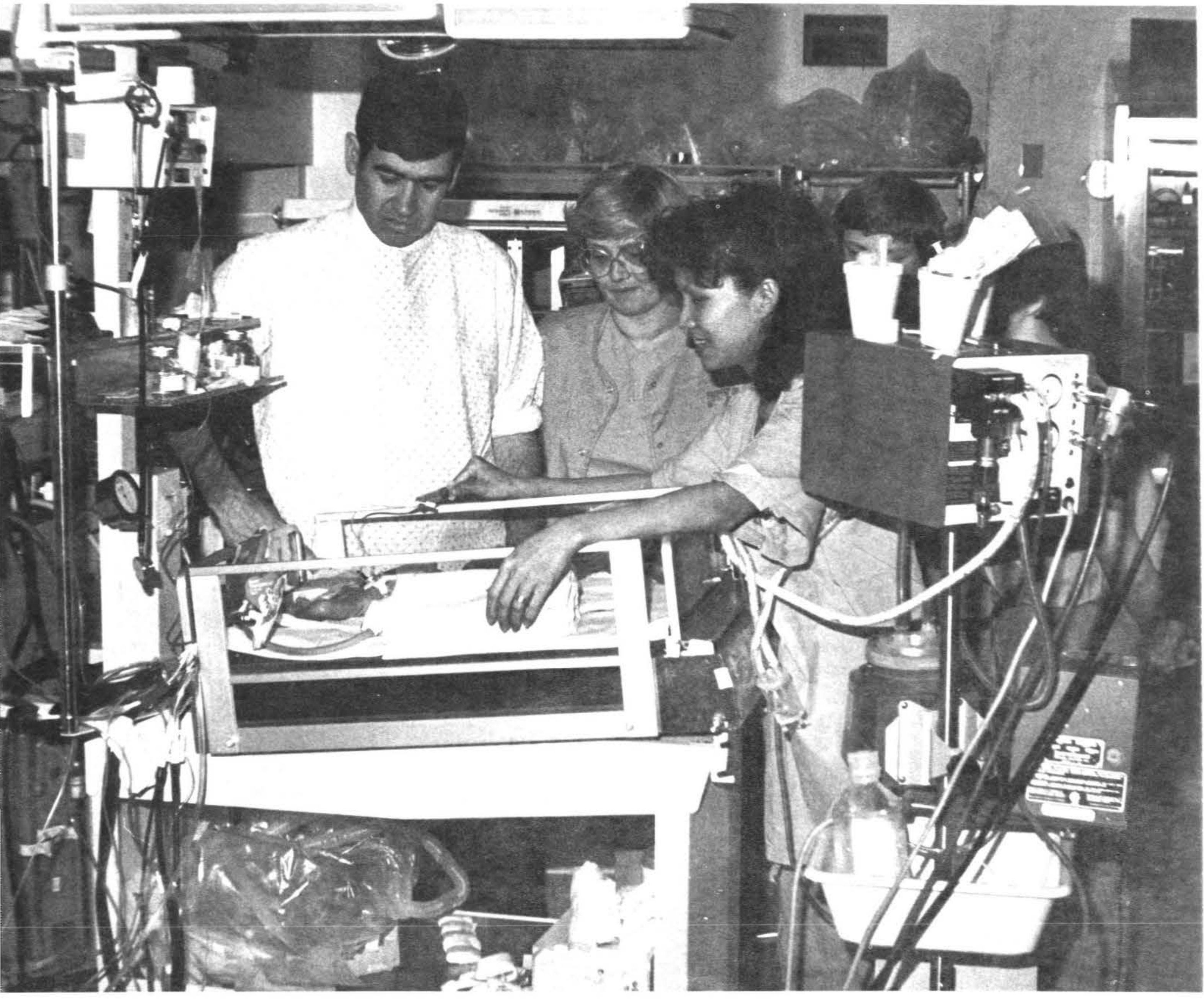
Davidson claims that working with the parents can be the most satisfying aspect of her work. However, she explains, "Sometimes you may sense a certain resentment from the infant's mother; this is a natural reaction in many cases because she is unable to care for her child, who is dependent on the nurse. You must realize the resentment is not personal and may be caused by underlying reasons. It is a challenge for us to uncover those reasons and help eliminate them. We are not a replacement for the parents—and don't want to be. We are here to provide understanding and help to parents."

Support comes from within the neonatal ICN itself. Davidson points out, "We know each other so well, we are able to help one another through difficult situations. This is especially true after the death of an infant. It is not uncommon for the nurses to attend memorial services for patients they have cared for over several months. "We don't do it just for the family that we've come to know, but for ourselves. It ties up the process so we are able to go on," Davidson says.

Neonatal care is best approached by "team care" of medical and nursing staff.(*3*) The rewards of this approach are evident. Davidson gives credit to the doctors saying, "I've never worked with such nurse-oriented doctors; their attitudes make our jobs as nurses easier and more enjoyable."

Being a teaching hospital, there is a constant influx of doctors and medical students to the nursery. This allows a unique blend of personalities and opinions to be introduced and discussed in the unit.

"Despite all the long hours, emergencies, emotional stresses, and quiet



Neonatal care is best approached by "team care" of medical and nursing staff. Nurses Nancy Mok (right) and Joe Ann Davidson (center) confer with CDR J. Thorp, MC.

moments, knowing medicine can only do so much, one doesn't need to ask the nurses if it's all worthwhile. Nearing the end of a 12-hour shift, Davidson says smiling, "When we receive pictures of the babies we've cared for, some from years ago, . . . well, you know we all get such a thrill. The pictures are a good reminder for us."

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2. Ibid, p 149.

3. Campbell A: Which infants should not receive intensive care? *Arch Dis Child* 57(7): 569, 1982. □

—Story by Michele M. Daubner. Photo by HM1 Martin A. Gurnik.

Questionnaire Survey of Hearing Protector Use

LT John Schleifer, MSC, USNR
Charles Fankhauser, Ph.D.
CAPT C. Gordon Strom, MC, USN
Wayne Loyborg, M.S.

Hearing protective devices approved for use in the Navy's Hearing Conservation Program are listed in Appendix C of OPNAVINST 5100.23B. In a well managed regional hearing conservation program it is common practice to recommend stocking a variety of hearing protective devices. At Naval Hospital, Oakland we recommend stocking five sizes of single flange insert (V51R), three sizes of triple flange, moldable foam insert, ear canal cap, and muff types. Although line commands are ultimately responsible for providing personal hearing protective devices, the fitting of insert devices and monitoring the distribution and replacement of hearing protective devices are Medical Department responsibilities.

Recently we investigated the affect certain personal hearing protective devices had on various noise warnings used in some Navy work environments. As a consequence, we first had to determine which hearing protective devices among the available supply were preferred by personnel working in such environments. We developed a questionnaire for active duty personnel who are required to use personal hearing protection for control of noise exposure.

Questionnaire responses and pure tone air conduction thresholds were obtained from 374 active duty personnel employed in various occupations requiring personal hearing protection. We were specifically interested in learning about users' reasons for satisfaction and dissatisfaction, whether there were any age level preferences in choice of protector type, and the relationship of these preferences to respondents' hearing threshold levels.

One hundred eighty-four expressed reasons for satisfaction with a personal hearing protective device. These users overwhelmingly favored a comfortable, effective protector easy to insert or wear.

One hundred forty-five expressed reasons for dissatisfaction with a personal hearing protective device. They also expressed a primary concern for comfort. This is not a surprising result, as many noisy occupations require long exposure duration; comfort would likely rank highly. The inability to hear sounds that need to be heard is also a concern for these users.

Respondents were surprisingly uniform in establishing clear choices for preferred types of devices. Moldable foam inserts and circumaural muffs were highly preferred. We did not anticipate that 88 percent of our responding population would prefer one of two types of protectors from among the variety offered.

Preferences for devices were also correlated with age for five age groups. Table 1 shows age groups as a function of most preferred hearing protector type for each of five types. It also shows that there are really no appreciable differences in preferences among the five groups.

We found clear user preferences for type of devices used, with consistent reasons for these choices. A small group of 66 respondents answered an open-ended question about how hearing protective devices could be improved. We categorized 19 separate

TABLE 1. Type of Personal Hearing Protective Device Preferred by Users as a Function of User Age

Type Protector Preferred	Percent of Each Type Preferred by Age				
	17-19	20-21	22-23	24-29	30+
Moldable foam	17	19	22	24	18
Ear muffs	23	24	20	15	18
Single flange	14	14	14	28	30
Ear canal caps	31	17	14	10	28
Triple flange	50	16	0	0	34

When this article was written LT Schleifer was on the staff of the Department of Otolaryngology at the Naval Hospital, Oakland, CA. He is now with the U.S. Air Force stationed at Wright-Patterson Air Force Base, OH. Drs. Fankhauser and Strom are on the staff of the Department of Otolaryngology, Naval Hospital, Oakland. Mr. Loyborg is attached to the Occupational Safety and Health Office, Mare Island Naval Shipyard, Vallejo, CA.

suggestions; 46 of the total 66 responses (70 percent) were included in six categories. We were surprised to learn that for one of four respondents in this subgroup, availability of devices was a problem. Clearly, there is a gap between standard inventory recommendations and current practices in some Medical Department facilities. This is, of course, an unacceptable situation. Consequently, we revisited installations for which we are responsible and corrected this problem where we found it.

Did some jobs held by our respondents relate to hearing loss more than others? Table 2 shows averaged audiograms for all job classifications. No significant differences were found.

TABLE 2. Averaged Audiograms by Occupation

Job Title	Frequency (kHz) 0.5	1	2	3	4	6
Boiler Technician	12.5	11.2	8.5	13.5	16.0	17.0
Electrician	12.0	10.5	10.0	12.0	14.0	16.0
Engineman	11.0	11.0	8.0	11.0	15.5	16.0
Hull Technician	12.5	10.0	8.0	14.5	18.5	18.0
Intercommunication Technician	13.0	13.0	12.5	18.0	20.0	18.5
Machinist's Mate	12.5	11.5	9.0	14.5	15.0	16.5
Fireman	12.5	12.5	9.5	11.5	13.5	16.5

We also compared hearing test results with number of years of individuals' noise exposure. Predictably, we found that hearing loss was directly proportional to number of years of noise exposure. Additionally, we averaged audiograms for users of each of the five types of hearing protection and for those subjects who indicated they did not use hearing protection. No significant differences were found among the groups. It is important to remember that our subjects were young and significant differences distinguishing protection users from nonusers may yet to be manifested following additional years of noise exposure.

Of those subjects responding in regard to satisfaction/dissatisfaction, 181 (62 percent) indicated they were satisfied with at least one of the devices; 112 subjects (38 percent) indicated they were dissatisfied with all the devices they had tried. Users of hearing protection who were satisfied reported using hearing protection during noise exposure 78 percent of the time; dissatisfied users reported using hearing protection 72 percent of the time. It is notable that dissatisfied users employed hearing protection about as much as satisfied users. We suggest that this is an indirect compliment to an emphasis on hearing conservation. We noted no significant differences between averaged hearing test results of satisfied and dissatisfied users of personal hearing protective devices.

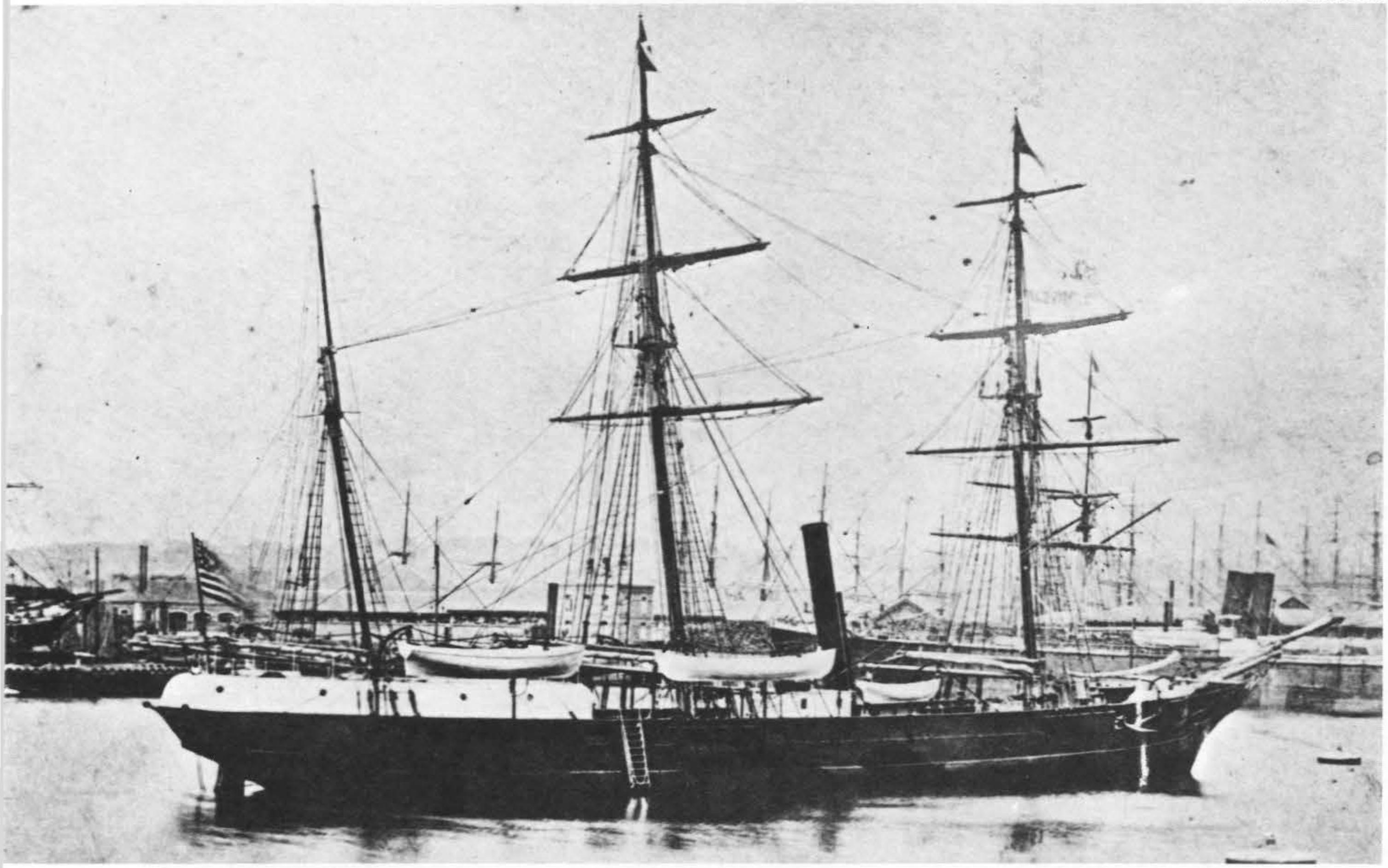
From this survey, we concluded:

- Age is directly related to increased hearing loss.
- Number of years of noise exposure is directly related to increased hearing loss.
- The various types of hearing protection seem to be equally effective, whether or not the individual is satisfied with the devices.
- Two types of protectors, moldable foam inserts and ear muffs, were the most preferred. However, a stock of several additional types of hearing protection is important to allow individuals the choice of a preferred device. We do not think this point can be emphasized too strongly. User preferences remain strongly individual, so a successful hearing conservation effort demands a variety of protector types.
- Increasing the availability of hearing protection devices was the suggestion most often given for improving use. From our experience, we suspect that a single hearing protector issue station at some distance from a noisy worksite may contribute to the perception that devices are unavailable. In this situation the person must wait, sometimes for long periods, before having the opportunity to obtain protection. If this is true, then methods of hearing protector distribution should be modified. It is notable that a single distribution center is found in many Navy installations. We now recommend that a dispensary staffed with technicians trained in earplug fitting techniques be the primary distribution site for all types of hearing protection devices. In addition, we suggest that several secondary issue stations should be established near noise-hazardous operations. These secondary sites should stock only those devices which do not require fitting (moldable foam inserts, ear muffs, or canal caps). For example, a box of moldable foam inserts might be kept in an easily accessible locker near the engine room of a ship and at other noisy shipboard locations. Periodic monitoring of stock of all distribution points would of course be essential.

Comment

We plan to expand this survey to include a larger population with a wider age range. Even though these data show no difference in hearing levels between users and nonusers of hearing protection, we feel that this is strictly a characteristic of the responding population and that as this group ages, nonhearing protection users will be significantly distinguishable from hearing protection users by hearing threshold levels. □

Naval Historical Center



The Jeannette *prior to her refitting.*

Tragedy at Lena Delta

For many casual and serious students of exploration the names Kane, Greely, Nansen, Amundsen, Peary, and Byrd are forever linked with the Arctic. But how many remember George De Long, George Melville, James Ambler, and the voyage of the *Jeannette?*

In a basement storeroom at the Naval Medical Command's Building Two rests a massive bronze tablet that once hung in the Naval Medical School library. It commemorates the tragic fate of Passed Assistant Surgeon James Markham Ambler and his fellow crewmen of the arctic steamer *Jeannette*. Their story, although but a footnote in history, is worth retelling. It reads like a classic novel with all the essential ingredients—discovery, adventure, sacrifice, heroism, and the struggle to survive against the odds. The story of the *Jeannette* began in the 1870's with a young naval officer's ambition to conquer one of the Earth's last frontiers—the North Pole—and ended along the frozen banks of Siberia's Lena River in 1883.

Birth of an Expedition

By the last quarter of the 19th century many nations, including the United States, had already tried and failed to reach the North Pole. Some explorers were forced to turn back when polar ice blocked the way. Others who believed the pole might be accessible by ship ventured too far and became entrapped in the ice, suffering frightful losses of life. Yet the quest continued.

LCDR George W. De Long made the next attempt. The Naval Academy

Four players in the *Jeannette* drama

Publisher James Gordon Bennett funded the expedition.

LCDR George W. De Long was its commanding officer.

Naval Medical Command Archives

Passed Assistant Surgeon James M. Ambler chose to share the fate of his starving comrades.

Chief Engineer George Melville survived to recover his shipmates' remains and tell their story.

graduate had served aboard several warships before getting his first arctic experience helping search for the missing exploring steamer *Polaris*. His determination to return to the Arctic translated into a correspondence and a friendship with James Gordon Bennett, owner of the *New York Herald*. Would Bennett be interested in funding an expedition if the Navy supplied the officers and men? The answer was an emphatic yes. The controversial and somewhat eccentric publisher was one of the wealthiest and most powerful men of his time. When the news lagged, he created it. It was the *Herald* that had sent Henry Stanley to Africa in search of the missing Dr. David Livingston.

Bennett wasted no time. He purchased the *Pandora*, a 142-foot barque-rigged steamer in England, renamed her the *Jeannette*, and brought her to San Francisco for refitting. Wielding power and influence, he engineered a bill through Congress that converted the ship into a U.S. Navy vessel. The act also authorized the Secretary of the Navy to detail line officers and crewmen to the *Jeannette*. LCDR De Long would head the expedition.

Refitting began at a San Francisco yard. Shipwrights buttressed portions of the *Jeannette*'s wooden hull inside the bow with solid Oregon pine. They sheathed the stem with wrought iron and iron straps bolted to her outer planking. From the waterline to below the turn of the bilge, American elm planks were added which gave the hull a new thickness of over 19 inches. Workmen bolted massive wooden beams athwartship for lateral strength and installed new boilers. Felt insulation was applied to the insides of the wardroom and forecastle. By July 1879 the work was completed and 3 years' worth of coal and provisions were loaded aboard. Few doubted that the *Jeannette* was as ready for arctic cruising as any ship had ever been.

Bennett and the Secretary of the Navy exercised much care in picking the crew. LT Charles W. Chipp, second in command, was a trusted officer and first-rate seaman. The navigator was LT John W. Danenhower. Chief Engineer George Melville, an experienced Civil War ironclad veteran, was in charge of the ship's engines and other machinery. Ice pilot William Dunbar, an ex-whaler, was said to have cut his teeth on the polar ice. Raymond Lee Newcomb, the expedition's naturalist and taxidermist, hoped to study and bring home specimens of arctic flora and fauna. Bennett himself appointed Jerome Collins, *New York Herald* staff weather reporter, as meteorologist.

The *Jeannette*'s physician was 31-year-old James Markham Ambler. Ambler had begun his military career as a 16-year-old Virginia cavalryman

Track of the Jeannette *and her crew*

1. *Frozen in ice 6 Sept 1879*
2. *18 April 1880*
3. *13 Aug 1880*
4. *26 April 1880 and returned almost to same position 3 Nov 1880*
5. *Discovered Jeannette Island 17 May 1881*
6. Jeannette *crushed by ice 12 June 1881*
7. *Discovered Bennett Island 29 July 1881*
8. *Boats separated by gale 12 Sept 1881*
9. *Melville's landing 16 Sept 1881*
10. *De Long's landing 17 Sept 1881*

Peninsula
Ostrov Karaginskiy
Olyutorskiy Poluostrov
Sea of Okhotsk
Sakhalin
Sovets Gavan'
Okha
Moskal'vo
Nikolayevsk
KOMSOMOL'SK
Sofiysk
Amur
Katangli
Nysh
Tatar Strait
Olyutorskiy
Palana
Anapka
Pakhacha
Tilichiki
Korf
Kamchatskaya Oblast'
Zaliv Shelikhova
Koryakskiy Avtonomnyy Okrug
Meynypil'gyno
MAGADAN
Palatka
Stekol'nyy
Atka
Evensk
SHANTARSKIYE OSTROVA
Udskaya Guba
RUSSIAN
Anadyr'
Markovo
Otrozhnyy
Omsukchan
Orotukan
Ust'-Omchug
Spornoye
Seymchan
Stokovaya
Omolon
Okhotsk
Magadanskaya Oblast'
Taskan
Yagodnoye
Khabarovskiy Kray
Chukotskiy Avtonomnyy Okrug
Arctic Circle
Susuman
Bol'shevik
Myaundzha
Arkagala
Plamennyy
Aliskerovo
Bilibino
Allakh-Yun'
Komsomol'skiy
Chaunskaya Guba
Anyuysk
Zyryanka
Oymyakon
El'dikan
Ust'-Maya
Pevek
Cherskiy
Nizhnekolymsk
Ust'-Nera
El'ginskiy
Zelenyy Mys
Srednekolymsk
Dzhebariki-Khaya
Mikhalkino
Mys Shelagskiy
Ostrov Ayon
SOVIET
Khandyga
Amga
Khonu
Ytyk-Kyuyel'
Churapcha
Chul'man
Tommot
Aldan
Belaya Gora
Borogontsy
Pokrovsk
OSTROVA MEDVEZH'I
Kangalassy
YAKUTSK
Namtsy
Burgavli
Indigirka
East Siberian Sea
Logashkino
Yakutskaya ASSR
Kotenko
Chokurdakh
Isit'
Ese-Khayya
Sangar
Batagay
Deputatskiy
Verkhoyansk
Tas-Tumus
Olëkminsk
Ust'-Kuyga
Yana
Ostrov Bol'shoy Lyakhovskiy
Ust'-Yansk
Kazach'ye
Kular
Vilyuysk
Ostrov Novaya Sibir'
Nizhneyansk
FEDERATED
Verkhnevilyuysk
Suntar
Zhigansk
Nyurba
Lensk
NEW
Ostrov Faddeyevskiy
Lena
Ostrov Stolbovoy
Tiksi
Almaznyy
Ostrov Bennetta
SIBERIAN
Ostrov Kotel'nyy
Mirnyy
Kotel'nyy
ISLANDS
Sklad
Chernyshevskiy
Taymylyr
Udachnyy
Aykhal
Irkutska
Oblast
Laptev Sea
Ust'-Olenëk
Olenëk
Saskylakh
U. S. S.
Ostrov Bol'shoy Begichëv
Ostrov Preobrazheniya
Nordvik
SOCIALIST
Tura
Poluostrov
Khatanga
Yessey
Evenkiyskiy Avtonomnyy Okrug
Ostrov Bol'shevik
Mys Chelyuskin
SEVERNAYA ZEMLYA
Taymyr
Taymyrskiy
Ostrov Oktyabr'skoy Revolyutsii
Volochanka
Krasnoyarskiy
Ostrov Komsomolets
Avtonomnyy Okrug
Noginskiy
Ostrov Pioner
Ostrov Shmidta
Mys Sterlegova
Talnakh
Noril'sk
Snezhnogorsk
Turukhansk
Kray
Dudinka
Igarka
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Ostrov Uyedineniya
Yermakovo
Vereshchagino
Yenisey
Ust'-Port
Oshmarino
Dikson
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Kara Sea
Gydanskiy
Ostrov Sibiryakova
Ostrov Greem-Bell
Gyda
Poluostrov
REPUBLIC
FRANZ JOSEF LAND
Ostrov Vil'cheka
Mys Zhelaniya
Tazovskiy
Urengoy
Tarko-Sale
Ostrov Belyy
Tadebyayakha
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Nagurskoye
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Poluostrov Yamal
Mys Kamennyy
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Nyda
Avtonomnyy
Nadym
Mys Kharasavey
Kvitoya
Okrug
Surgut
Nordaustlandet
NOVAYA ZEMLYA
KONG KARLS LAND
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Khal'mer-Yu
Salekhard
Labytnangi
Promyshlennyy
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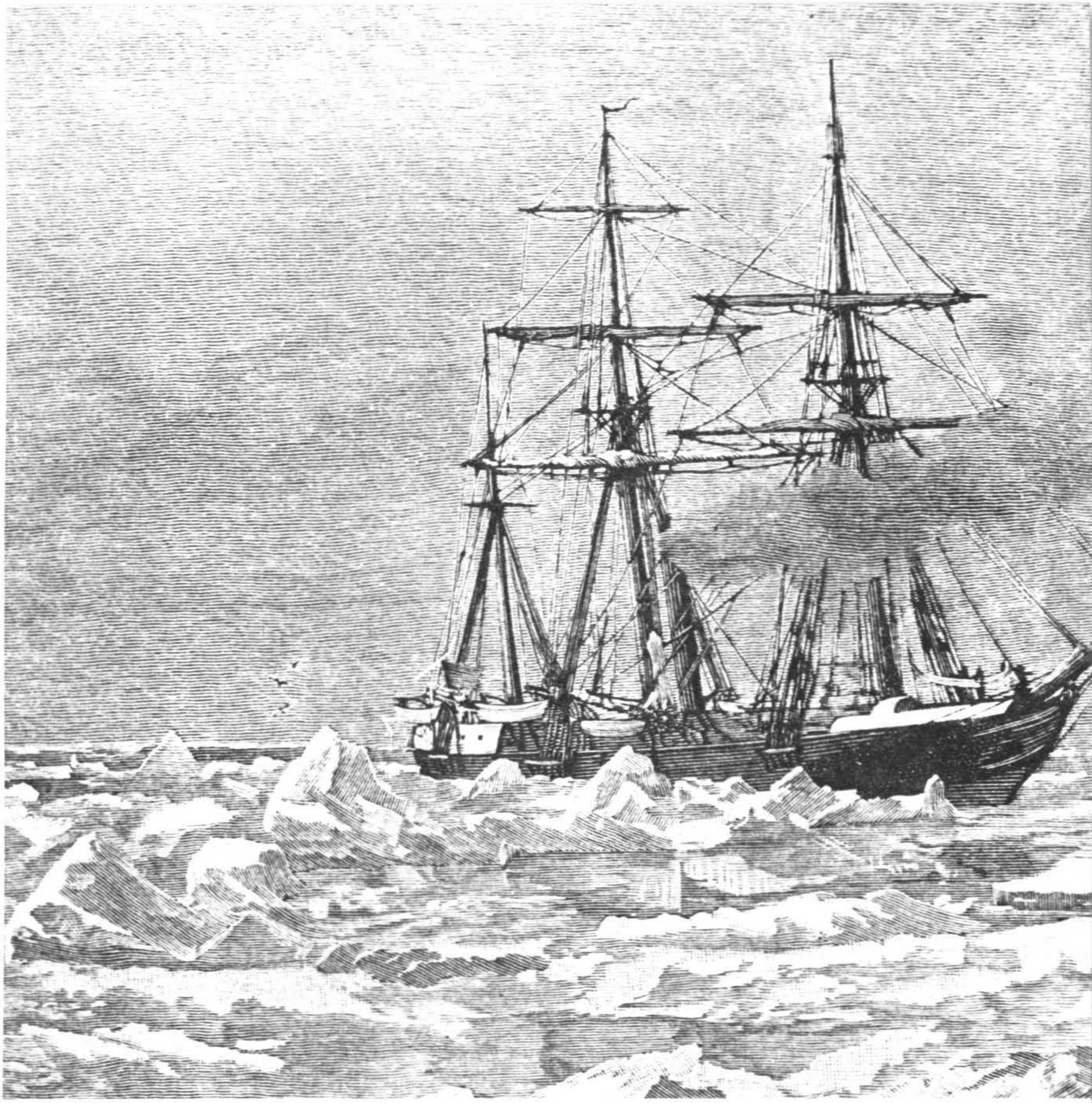


Illustrations from *The Voyage of the Jeannette: The Ship and Ice Journals of George W. De Long*

fighting for the Confederacy. After the war he studied medicine at the University of Maryland and joined the Navy in 1874. While stationed at the naval hospital in Norfolk, the passed assistant surgeon received a telegram from De Long asking him to join the crew. For Ambler, the prospect of arctic adventure was irresistible.

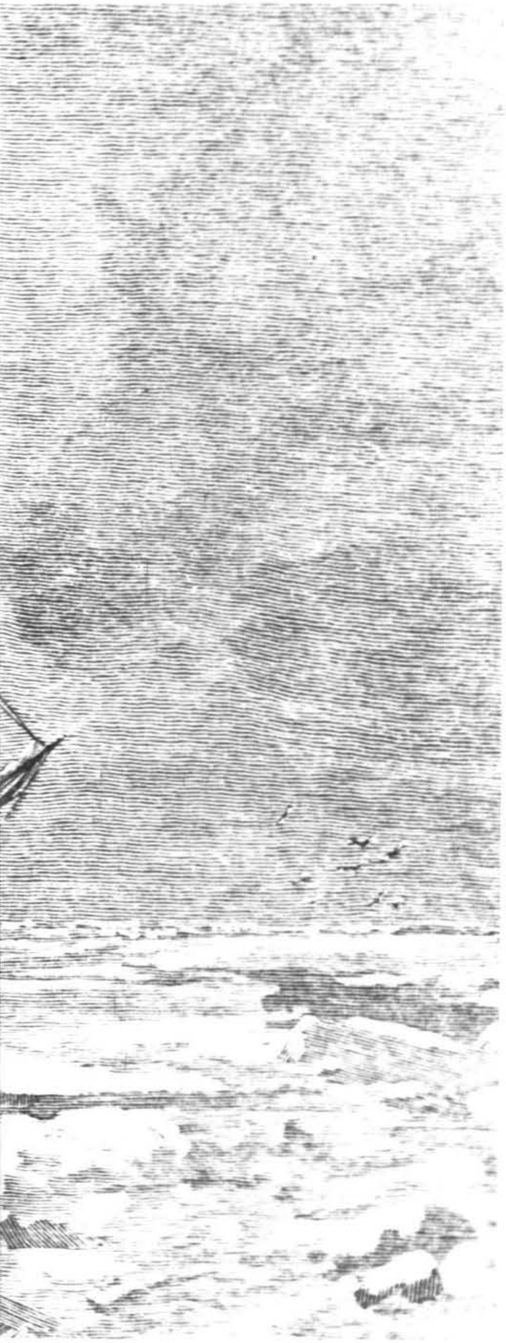
On to the Pole

On 8 July 1879, festooned with signal penants and with appropriate ceremony, the *Jeannette* weighed anchor, steamed through the Golden Gate, and set her course for the North Pole.

The ship put in at several Alaskan ports to take on sleds, dogs, other supplies, and two Alaskan Indians as hunters and dog-drivers. After crossing the Bering Strait and stopping at Kolyuchin Bay on the Siberian coast, the *Jeannette* headed north toward Wrangel Island. De Long, like many of his contemporaries, hypothesized that Wrangel Land, as it was then called, was part of a continent that traversed the pole and became Greenland on the other side. If necessary, he would anchor the ship on Wrangel Land's south coast and continue the trek to the pole by dog sled.

Ice Prisoners

Just 2 months after leaving San Francisco, the *Jeannette* suddenly encountered heavy ice. De Long carefully threaded her through the floes but on 5 Sept 1879 all progress ceased. The following morning captain and crew awoke to find themselves stuck fast. "As far as the eye can range is ice, and not only does it look as if it had never broken up and become water,



Left: On 12 June 1881 the ice closed in on the Jeannette *for the last time.*

The crew retreated south across the frozen sea toward open water dragging their boats and supplies with them.

A gale separated the three boats.

but it also looks as if it never would," wrote De Long in his journal.(*1*) The expedition and its hopes were imprisoned for an indeterminate sentence. The men could only hope to survive a winter in their greenless, white, monochromatic world and wait for spring.

Monotony and isolation coexisted with challenge and discovery. During the day the men left the ship and hunted seal, walrus, and polar bear to augment their diet of canned chicken and turkey, a fare the crew described as looking like "a railroad accident."(*2*) At dusk the brilliant ice glare often gave way to breathtaking auroral displays and skies drenched with stars. As ice pressured the hull, one could hear the snapping and crackling of bolts and timbers. Windless nights were ghostly quiet but for the barking of the dogs. And each succeeding day the ice pack drifted northwestward with its prisoners. The days grew shorter until the pale sun disappeared altogether and the temperature dropped to -45°.

On 19 Jan 1880 the *Jeannette*'s fragility became more evident. Skipper De Long described "a loud noise as if the cracking of the ship's frame from some great pressure."(*3*) His worst fears were confirmed as icy water suddenly poured into the bilges. Only heroic efforts at the pumps kept the rising water in check. For months crewmen manning hand pumps worked around the clock just to keep ahead of the water; steam pumps alone were not enough to keep the ship afloat.

The persistent leak and the heaving of the ice were indeed worrisome. "The noise was not calculated to calm one's mind," De Long wrote. "I know of no sound on shore that can be compared to it. A rumble, a shriek, a groan, and a crash of a falling house all might serve to convey an idea of the noise which this motion of ice-floes is accompanied."(*4*)

Through the long months of aimless drifting, Dr. Ambler continued to practice his profession with utmost skill. His vigorous brand of preventive medicine kept the crew healthy. The men received their daily ration of lime juice and scurvy was never a problem. Neither did the young surgeon let down on sanitation and hygiene. He saw that garbage details removed the ship's refuse and he periodically sampled the ship's below-deck atmosphere for toxic gases and excessive dampness.

The procurement of fresh water was the biggest concern. "Should we be so fortunate as to return without having the scurvy break out among us, I think it will be because we had pure water to drink. . .," wrote Ambler.(*5*) The ice pack and snowfall in no way insured a ready fresh water supply, being far too salty for drinking or cooking. The ship's distilling unit worked overtime to keep up with the demand.

Ambler's one chronic patient was LT Danenhower, who suffered a serious eye affliction. For many months the navigator was confined to his bunk in great pain.

Retreat

The first winter gave way to spring but the ship remained stuck in the ice, no closer to the North Pole than months before. A second winter came followed by another spring. The routine wore on De Long and the crew. "There can be no greater wear and tear on a man's mind and patience than life in this pack. The absolute monotony; the unchanging round of hours; the wakening to the same things and the same conditions that one saw just before losing one's self in sleep; the same faces; the same dogs; the same ice . . ."(*6*) The *Jeannette*'s skipper faced the reality of inevitable defeat. "A ship having the North Pole for an objective point must get to the pole, otherwise her best efforts are a failure."(*7*)

On 12 June 1881 the ice ended the stalemate. The *Jeannette* broke free and lay in open water between two floes. All cheered to the possibility of continuing the voyage. Suddenly the ice shifted, the channel narrowed, and the ship's once stout hull gave way like an egg shell in a vise. Water slowly rose in the hold and the men abandoned ship, taking with them two small open cutters, a whaleboat, and 60 days' provisions. One by one *Jeannette*'s spars toppled and she slipped beneath the ice with but her foremast still upright. At 77° 15' North and 155° East, the crew was alone in the middle of the frozen East Siberian Sea.

What followed must be one of the most epic journeys in the history of arctic exploration. De Long and his 33-man crew began the long trek over the ice, dragging their boats and supplies with them. Their destination was the settlements thought to lie along the Lena River on Siberia's northern shore. Oak runners shod with whalebone had been affixed to the boats. One cutter weighed 3,000 pounds; the second 2,300 pounds; the whaleboat weighed 2,500 pounds. The five sleds with their provisions weighed close to 6,600 pounds. Ambler harnassed two starving dogs to a sled upon which he lashed surgical instruments, medical stores, and records and then took his turn on the tow ropes. Fissures and massive blocks of ice were in the way. The boats were so heavy that the entire crew first had to drag one, then another. They walked many miles back and forth just to gain but a mile or two nearer their goal. And only De Long knew that even as they trudged southward the ice was moving even faster northward.

The weather worsened—sleet, rain, and fog alternated with blinding glare. The men were always wet and Ambler's sick list grew. On 29 July 1881, after 42 days of terrible trials, they landed on solid ground, raised the American flag, and named the uncharted island Bennett in honor of their benefactor.* They rested several days and then continued their voyage south until they reached the New Siberian Islands. There they hunted and rested, embarking from Semenovski Island on 12 Sept.

That night a terrible gale from the northeast separated the boats. LT Chipp's cutter foundered with the loss of all hands. The remaining two boats under the commands of De Long and Chief Engineer Melville became separated and the former's craft nearly swamped. The "gale increased, carried away our mast at the foot & we became a wreck, taking in water, wallowing in the trough of the sea the whole night . . ." wrote Ambler.(*8*) Several days later the two boats came ashore many miles apart on the Lena Delta.

*The nearby islands of De Long and Jeannette today commemorate the skipper and his ill-fated ship.

Photo by Editor

The bronze tablet that once held a place of honor in the Naval Medical School portrays the departure of Seamen Nindemann and Noros.

Lost in the Delta

Melville's band, although exhausted and frostbitten, worked its way south for several days subsisting on tea and short rations of pemmican.* De Long's party fared poorly. Provisions ran low even though Alexae, one of the Alaskan natives, managed to shoot a deer. Slowed by the sick, they made little progress following the Lena River southward. Frostbite and hypothermia continued to take their toll. Ambler was forced to amputate the severely frostbitten foot of one crewman, who succumbed shortly thereafter. De Long decided and his surgeon concurred that no man would be left to die alone. The pemmican ran out and each day another crewman either sickened, weakened, or died. On 9 Oct Ambler wrote:

> Yesterday without food except the alcohol, the Capt. spoke of giving the men option to-day of making their way as best they could, that he could not keep up . . . . I told him if he gave up I took command & that no one should leave him as long as I was alive. I then suggested that we send two men ahead to try to make the settlement, and that we make the best of our way with the rest of the party. This was done . . . .(9)

Two of the strongest, W.F. Nindemann and L.P. Noros, were sent ahead to find help and De Long gave Ambler the option of going along but he refused, choosing instead to remain with the sick and ultimately to share their fate.

Three days later, out of food, the survivors drank grain alcohol fuel and ate short rations of glycerine. They sought shelter from the wind and snow in a hollow in the river bank. On the 18th Alexae expired. Those who were strong enough grawed strips of leather from their boots. And one by one they lay down to die.

Epilogue

Chief Engineer George Melville and his party encountered three natives on 19 Sept who fed and sheltered them and then showed the way to a Russian settlement.

*A concentrated, high energy food cake made of dried beef, raisins, suet, and sugar.

Photo by Editor

Dr. Ambler's grave is in a rural churchyard not far from his boyhood home.

Seamen Nindemann and Noros were rescued by other natives several days after leaving De Long and the others. Bad weather and difficulty in communicating with their rescuers delayed their reunion with Melville, who set out to find the De Long party. Hampered by a lack of provisions and bitter cold weather, Melville reluctantly concluded that De Long and his companions had perished. He decided to wait until spring to search for their remains.

The following March, Melville searched much of the Lena Delta before finding what he was looking for. He constructed a crude tomb and buried his comrades, marking the site with a 22-foot-tall wooden cross.

It was not until the close of 1883 that another U.S. Navy party returned to Siberia and recovered the frozen bodies. George De Long and several other members of the crew were reinterred in New York City with full military honors. Dr. James Ambler came home to a quiet country churchyard in the rolling foothills of Virginia's Blue Ridge. Years later Navy medical officers erected a bronze memorial in the simple, gothic, one-room church where Ambler and his family once had worshipped. Its simple, poignant inscription duplicates the tablet that once held a place of honor at the Naval Medical School. "His sense of duty was stronger than his love of life."—JKH

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Heat Stress Field Study

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J.E. Greenleaf, Ph.D.

Every summer the Marine Corps sends several thousand reservists to its Air Ground Combat Center, Twentynine Palms, CA, for 2 weeks of training. This article presents results from three separate field exercises in which data were collected on environmental conditions. It also discusses epidemiology of the heat-related casualty (HRC) and non-HRC populations and includes a compilation of anecdotal data from the field hospital staffs. The purposes of these investigations were to identify high-risk individuals and the activities that may contribute to increased casualty rates, to suggest procedures for prevention, and to increase the efficiency of remedial treatment with the ultimate goal of eliminating heat-related casualties.

Procedure and Methods

The senior author attended three major exercises and collected epidemiological information on two combined arms exercises (CAX) through the summers of 1979 and 1982. During those exercises, interviews were conducted with about 10 percent (263) of those personnel who never reported themselves as heat casualties (controls) during desert exercises. An HRC is defined as a person who reported to or was referred to either a battalion aid station or the field hospital with symptoms of high body temperature, nausea, cramps, heat exhaustion, or heat stroke. An epidemiological data sheet was completed for each casualty. Other cases of undocumented heat-related illnesses in the field, which were treated successfully by the unit corpsmen or by the patient's friends, were not included in this survey.

Environmental temperature and relative humidity were measured with a Thunder Scientific Corporation digital humidity and temperature measurement system (model HS-1CHDT-2A). A black-globe temperature was determined from a thermistor inserted

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TABLE 1. Heat-Stress Conditions

Condition	WBGT (^{0}F)	Limitations
I	≥80	Heavy exercise should be performed with caution and under close supervision.
II	≥85	Strenuous exercise should be suspended for unacclimated individuals for 2-3 weeks. Outdoor classes should be avoided.
III	≥88	All physical training should be halted for unacclimatized troops and for those who have not lived and worked in the area for at least 2 weeks. Acclimatized troops may carry on limited activity not to exceed 6 hr/day.
IV	≥90	All strenuous activity should be halted for all troops.

TABLE 2. Subjects by Area of Residence (Percent of Total)

Area	Controls	HRC 1979	HRC 1982	Combined HRC 1979 & 1982
Southwest, CA, HI	31	21	29	22
Northwest	13	4	0	3
Rocky Mts., Central Plains	6	0	0	0
Deep South	21	43	47	44
North Central	3	9	12	9
Northeast	21	17	6	16
Unknown	5	6	6	6

TABLE 3. Subjects by Military Grade (Percent of Total)

Rate/Rank	Controls	HRC 1979	HRC 1982	Combined HRC 1979 & 1982
PFC	10	14	29	16
LCPL	29	33	12	31
CPL	16	20	23	20
SGT	10	13	18	14
SSGT	7	7	0	6
GSGT	5	3	0	3
Officer	21	4	6	4
Unknown	2	6	12	6

TABLE 4. Hours of Sleep (Percent of Total)

Hours of Sleep*	Controls	HRC 1979	HRC 1982	Combined HRC 1979 & 1982
<2	0	10	6	10
2-3	6	28	41	30
4-5	49	35	35	35
6-7	41	20	18	19
>8	0	0	0	0
Unknown	4	7	0	6

*Amount of sleep the night before being sampled as a control or HRC.

into the center of a matte-black copper sphere 15 cm in diameter. Both natural and psychrometric wet-bulb temperatures were recorded. Cloud cover was estimated using a 0.0 to 1.0 relative scale for percent of sky coverage. The environmental conditions were recorded hourly between 0700 and 1700 at Twentynine Palms Marine Base Dispensary, at Camp Wilson's field hospital, and at various sites on the ranges.

The anecdotal medical information was collected from interviews with the medical staffs of the field hospital, battalion aid stations, corpsmen in the field, and from personal observation.

Results and Discussion

Environmental Conditions. The daytime temperatures were higher at the Camp Wilson field hospital area then at Twentynine Palms Dispensary station by about 1° to 3° C, and relative humidity was greater at Twentynine Palms by about 5 to 15 percentage units. The fluctuations and elevated relative humidity at Twentynine Palms were probably the result of increased vegetation and local sprinkling.

At Twentynine Palms the heat-stress conditions were divided into four categories based on the wet-bulb globe temperature (WBGT) index. Condition I is the least severe and condition IV the most severe. Table 1 shows the recommended activity levels at each heat-stress condition and corresponding WBGT. Since few of the reservists are heat-acclimatized, conditions II and III should be the limits of activity for these troops.

Condition IV is most likely to occur between 1200 and 1500 hours. About 10 percent of the time it can occur as early as 1100 and as late as 1600 hours during June, July, and August. The rate of temperature increase in the morning is almost exponential between 0900 and 1100, and declines rather slowly between 1500 and 1700 hours. The Corps exercises near the end of the summer (August to mid-September) are more likely to encounter high humidity, slightly cooler days, more cloud cover, and an occasional wind and rainstorm at night. Those during June and July are the most difficult for the unacclimatized reservists, and are the exercises most likely to increase the number of heat casualties.

The 1979 exercise period (14-28 July) was considerably hotter and drier than the 1982 exercise period (20 Aug-1 Sept). Although the casualty rate was about eight times higher than in 1982, considerations other than environmental temperature probably contributed to the reduced HRC rate in 1982.

Epidemiology. After reviewing the results of the surveys for the control population of each exercise, which showed that the differences were minimal, the data for the two control populations were combined. The data for both the control and HRC groups are presented as percentages of the total sample. Data from the HRC groups for the 1979 and 1982 exercises were also combined.

Table 2 presents data from the controls and casualties divided according to the section of the country in which the reservists lived. The hypothesis was that people from the cooler areas would be at a greater risk, and that those from the South and Southwest would be partially heat-acclimatized and thus at a lower risk. This hypothesis was not confirmed (Table 2). Personnel from the Deep South and north-central sections of the United States were at two and three times greater risk, respectively, than the controls. Although personnel from the Southwest, Hawaii, and the Pacific States composed about 44 percent of the population, only about 25 percent of the heat casualties were from these areas. Interviews with many of the casualties from the Deep South revealed that most lived and worked in air-conditioned houses and offices.

Table 3 presents the data according to rate or rank. Neither rate nor rank appeared to increase the risks above that which would be expected according to the general population. Since

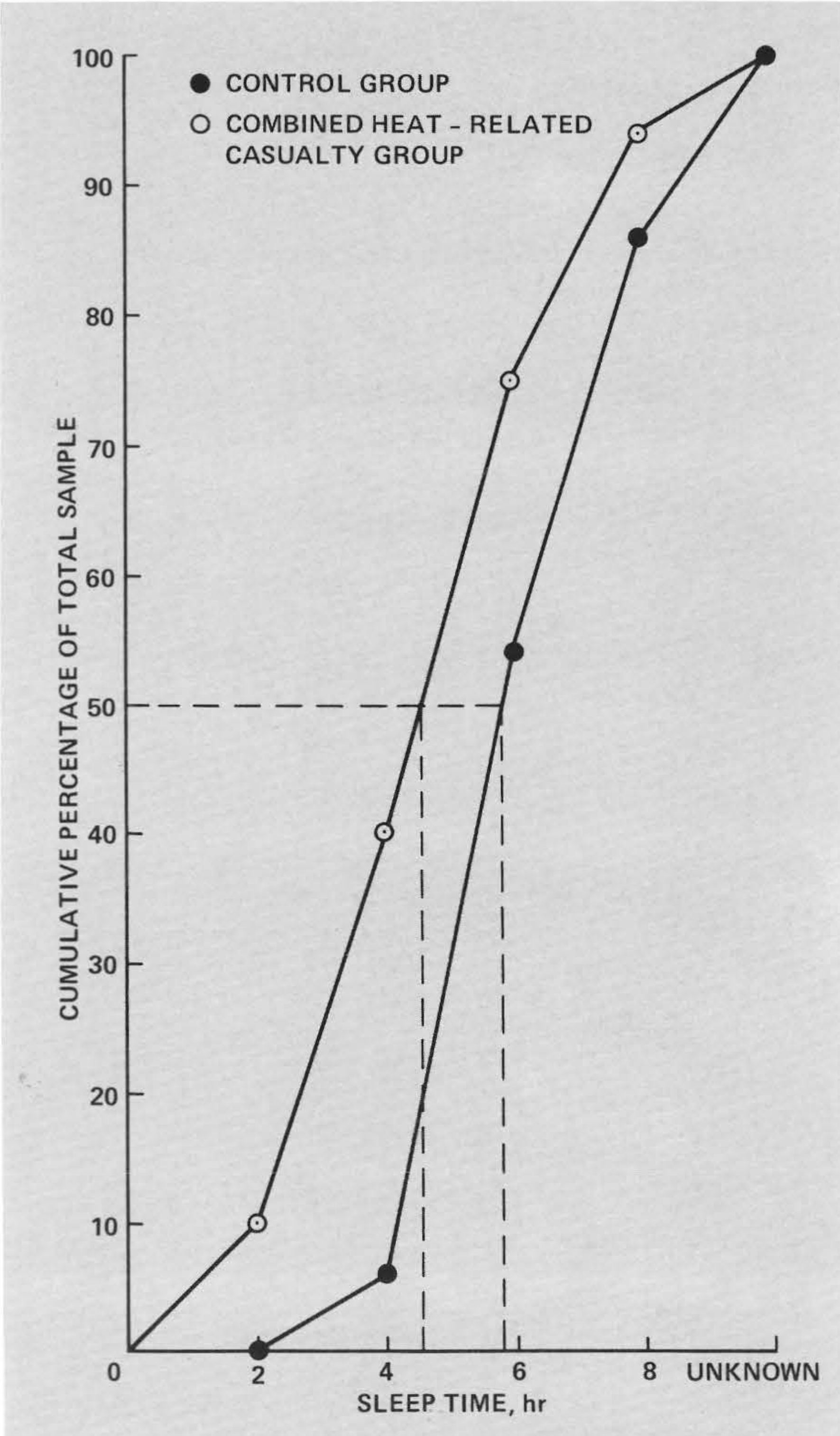

FIGURE 1. Average sleep time during the exercise in the control and HRC groups.

TABLE 5. Subjects by Race (Percent of Total)

Race	Controls	HRC 1979	HRC 1982	Combined HRC 1979 & 1982
Black	10	26	29	26
Caucasian	75	71	71	71
Hispanic/Am. Indian	2	0	0	0
Oriental	5	1	0	1
Unknown	8	2	0	2

TABLE 6. Subjects by Sex (Percent of Total)

Sex	Controls	HRC 1979	HRC 1982	Combined HRC 1979 & 1982
Male	95	95	88	94
Female	5	5	12	6
Unknown	0	0	0	0

TABLE 7. Beer Consumption (Percent of Total)

Can of Beer, 12 oz.	Controls	HRC 1979	HRC 1982	Combined HRC 1979 & 1982
None	36	58	65	59
<2	13	20	12	19
2-4	28	10	23	11
>5	23	5	0	5
Unknown	0	7	0	6

TABLE 8. Salt Use (Percent of Total)

Added Salt*	Controls	HRC 1979	HRC 1982	Combined HRC 1979 & 1982
Yes	39	63	47	61
No	59	30	53	33
Unknown	2	7	0	6

*Salt added to food other than field rations.

about 29 percent of the sampled control population were lance corporals (LCPL's) one would expect a similar percentage of the pooled heat casualties to be LCPL's, which was observed.

Since fatigue contributes to the incidence of heat exhaustion and heat stroke, the hours of sleep the patients had before becoming heat casualties were determined. Table 4 lists the reported hours of sleep each person had the night before becoming a heat casualty. None of the controls had fewer than 2 hours of sleep, whereas about 10 percent of the casualties had fewer than 2 hours. Fifty percent of the controls had about 5.8 hours of sleep, and 50 percent of the heat-related casualties (HRC) had about 4.5 hours (Figure 1). About 54 percent of the controls had 6 or fewer hours of sleep, whereas 75 percent of the casualties had 6 hours or less. It is interesting that 41 percent of the controls slept between 6 and 8 hours, and that only 19 percent of the HRC group had that much sleep.

Table 5 tabulates the data by racial type: Black, Oriental, Hispanic and American Indian, Caucasian, and unknown. Although Blacks comprised about 10 percent of the controls, they comprised about 26 percent of the HRC group.

There appeared to be no difference between the HRC and control groups with respect to sex (Table 6). The larger percentage of female HRC's during 1982 may be due more to the small size of the HRC group rather than an actual increase in the risks to females. Nothing in the field indicates that females are at a greater risk of becoming heat-related casualties. Compared with larger people, small women, as well as small men, may be under greater work stress when performing heavy manual labor. The female casualties in 1982 occurred while they were standing in formation on hot metal slats, which raises questions about the quality of their supervision. The 1979 female HRC group engaged in a wide range of noncombat tasks, i.e., cleaning trucks, riding in jeeps, attending lectures in the sun, and splicing wire.

Beer was available at night, and there was some concern that alcoholic intake contributed to the increase in the heat casualty rate. Table 7 lists the consumption of beer (12-oz cans) by the two groups. Seventy-five percent of the control population had fewer than 3.9 cans, and 75 percent of the HRC combined group had fewer than 1.7 cans (Figure 2). At the 50 percent level, the control group and the HRC combined group consumed 2.1 and 0.0 cans, respectively. The implication of these data is that a few cans of beer at night might be beneficial. Although data exist that show a dehydrating effect of alcohol on fully hydrated individuals, no data are available that indicate if alcohol has a potential rehydrating effect on slightly or moderately dehydrated people. Possibly, with dehydrated individuals, American beer with its low alcoholic content may have a positive rehydrating effect. (Similar observations of beer consumption after work in hot environments have been reported in South African mine workers and in iron and steel mills in the northeastern United States.) The effect of salt added to beer consumed by mildly dehydrated individuals has not been fully investigated; it may prove to be beneficial, particularly if proper meals, especially the evening meals, are not eaten regularly.

When asked if their food, other than field rations, was salted, the controls reported affirmatively in 39 percent of the cases. By comparison, 61 percent of the HRC combined group reported adding additional salt to their food. Table 8 lists the percentages of those who salted their food when not eating field rations. Since members of the HRC groups appeared to have salted their food more frequently than the control population, the next question should ascertain the amount of water consumed. If the HRC group was consuming more salt, they should have been consuming more water.

Table 9 categorizes the volume of water (number of 1-liter canteens) consumed other than that taken at

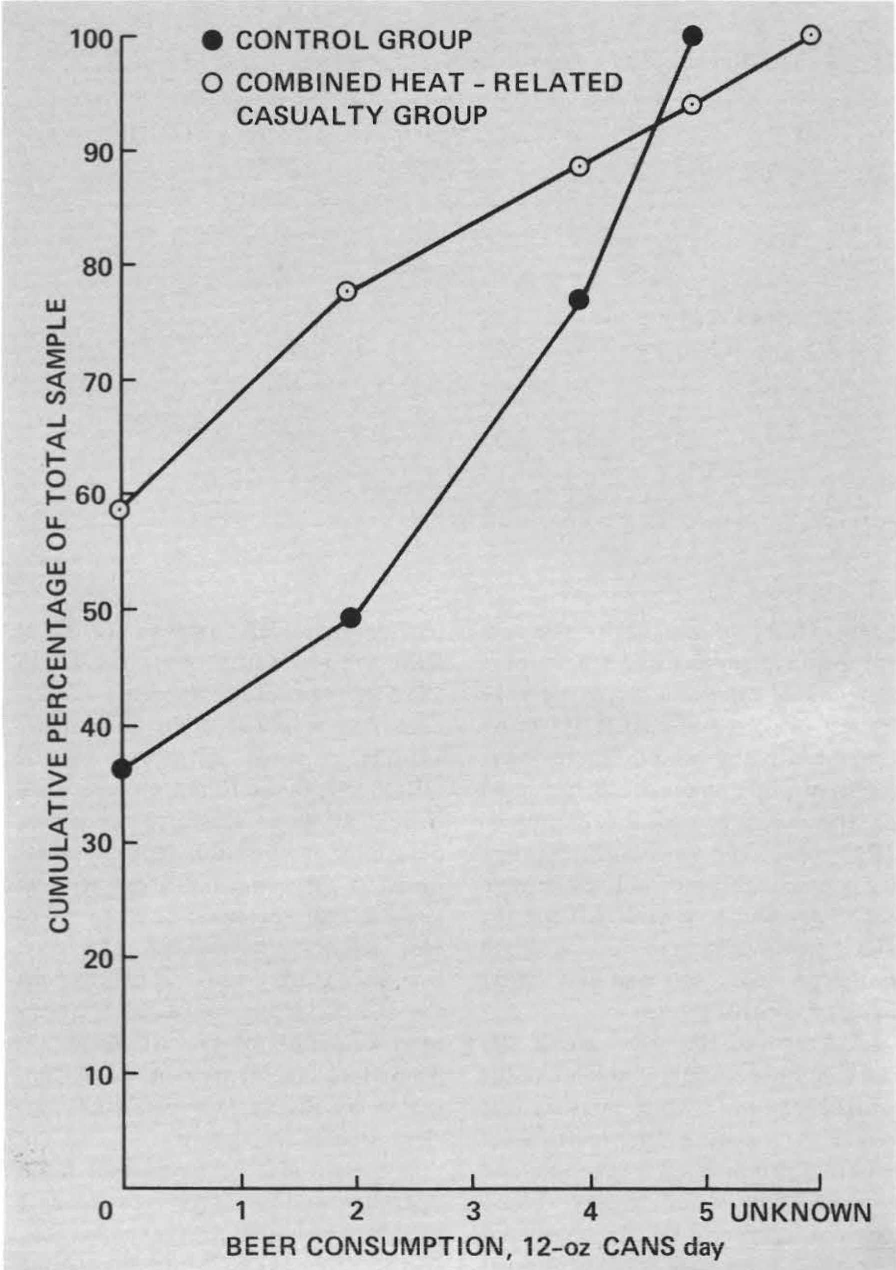

FIGURE 2. Average beer consumption by the control and HRC groups.

TABLE 9. Water Consumption (Percent of Total)

Canteens	Controls	HRC 1979	HRC 1982	Combined HRC 1979 & 1982
<2	13	15	12	14
3-5	51	69	65	68
6-8	26	12	17	13
>9	10	4	6	5
Unknown	0	0	0	0

TABLE 10. Water Consumption Patterns (Percent of Total)

Drank on Schedule	Controls	HRC 1979	HRC 1982
Yes	41	No	47
No	59	Data	53
Unknown	0		0
Drank When Thirsty			
Yes	46	No	71
No	52	Data	29
Unknown	2		0

meals. Thirty-six percent of the control group members had six or more canteens of water, whereas only 18 percent of the combined HRC's consumed that much water. On the lower end of water intake, the percentages for the controls and the combined HRC group who consumed less than five canteens of water were 64 percent and 82 percent, respectively. Thus, the HRC group appeared to consumed somewhat more salt and less water than the control group.

It seems that the HRC group was drinking on a schedule, much like the control group. Table 10 lists the results concerning the method of drinking: drinking on a schedule and drinking only when thirsty. There does not appear to be any significant difference in the two groups concerning schedule drinking, but when asked if they drank only when thirsty, the difference becomes more noticeable. Seventy-one percent of the HRC group drank only when thirsty; only 46 percent of the control group drank only when thirsty. Again, the HRC group was probably not drinking enough water.

Another interesting point gained from the interviews with the HRC group concerned the level and type of activity they were engaged in before becoming a casualty. In 1979 63 percent of the heat casualties were riding in, or had been riding in, a vehicle (helicopter, jeep, amtrak, tank) at least 1 hour before becoming ill. In 1982 the percentage was only 42 percent. As a followup of the 1978 observations, a study sponsored by the Office of Naval Research was conducted at Ames Research Center to determine if vibration reduced tolerance to hot environments. Results suggest that the low-frequency (5-16 Hz), whole-body vibrations reduced tolerance during heat exposures with the effects lasting for at least 1 hour after cessation of the vibration.(*11*) These frequencies are commonly generated by the various personnel carriers used in the desert.

It should also be noted that radio operators and personnel who lay wire tended to be higher heat casualty risks. In the 1978 HRC group there were large numbers of heat casualties associated with cooking and cleaning in the galley, while in the 1982 HRC group no casualties were associated with food preparation services. The difference in casualty rate between these two galley crews was possibly due to the construction of a permanent food service structure after 1979 and to lower temperatures during the 1982 exercise.

There is always the possibility that an HRC may provide the expected answer when questioned and may not be providing the truthful answer; however, most of the information sought cannot be categorized into right or wrong answers. Assuming most of these answers were truthful, then some factors can be reported which were found to be associated with the HRC group. Again, a cause-and-effect relationship has not been shown in this study, only an association. The following points should be emphasized.

- Exercise or inappropriate working levels above environmental heat-stress condition II resulted in more HRC's.
- People from warmer sections of the country may be at greater risk of heat-related illnesses since many live and work in air-conditioned homes and offices and may not attain a sufficient level of natural heat acclimatization.
- The importance of sleep should be emphasized more, with at least 6 hours being the recommended minimum.
- Women did not appear to be at greater risk than men.
- Consumption of fewer than five 12-oz cans of beer at night was not associated with a reduced tolerance to the heat and may actually be beneficial as a fluid replacement mechanism; more data are needed.
- The heat-related casualty group seemed to be drinking insufficient fluids. The onset of thirst is not a good indicator of the level of dehydration because exposure to heat, exercise, and dehydration masks the feelings of appropriate thirst.(*3*) Troops must be forced to drink before thirst becomes apparent or progressive dehydration will result, particularly when working or marching.

Treating Heat Casualties in the Field. Spray-misting a seminude heat casualty on a net hammock is a more efficient procedure for removing body heat(*13*) than immersing in ice water or covering the patient with ice water-soaked sheets.(*1,4,12*) Spray-misting applies a film of water onto the skin that allows for evaporative cooling, the most efficient means of heat dissipation, especially if a fan blows air across the patient. The net hammock allows evaporation to occur from the back of the patient as well. Skin cooling is maximized with spray-misting.

Immersion of the patient in ice water relies on conductive-convective cooling (a less efficient method than evaporation) that requires heat to be transported from the muscles and organs to the skin via the blood where heat is transferred from the warmer blood to the ice water cooled skin. However, excessive cooling of the skin will virtually abolish peripheral blood flow, and heat transfer will be severely curtailed. As a result, core temperature may even increase because heat production exceeds heat dissipation. Also, in the field, the standing ice water bath procedure is not as practical as spray-misting. The spray-mist water need not be cooled; it can be warm but should not be allowed to become hot. Evaporation of 1 ml of warm water removes essentially the same amount of heat as evaporation of 1 ml of cold water.

In all but extremes cases, localized spraying of the body may be better than whole body spraying. Localized spraying tends to reduce shivering, which increases heat production, and to reduce the degree and duration of vasoconstriction in the skin. Spray-cooling should be started in the field by the unit corpsmen. The head and neck area, chest and back, arms and hands, and legs and feet are four localized areas that should be sprayed as units.

Hand-pump sprayers, which are commonly sold for home insecticide use (2- to 3-gal capacity), can be issued to each battalion aid station and to the field hospital. One-quart hand sprayers, which are used to mist house plants, work well for the corpsmen, are cheap, and can be filled from a canteen. In 1982 15 one-quart sprayers were given to hospital corpsmen with the marines on the range during the live-firing exercises. All corpsmen spoke highly of the efficiency of the sprayers in the field and reported that after patients were cooled and allowed several hours of rest with oral rehydration, many of the potential casualties were returned to their units without further treatment. Many heat casualties would normally have been sent to the battalion aid station or to the field hospital at Camp Wilson.

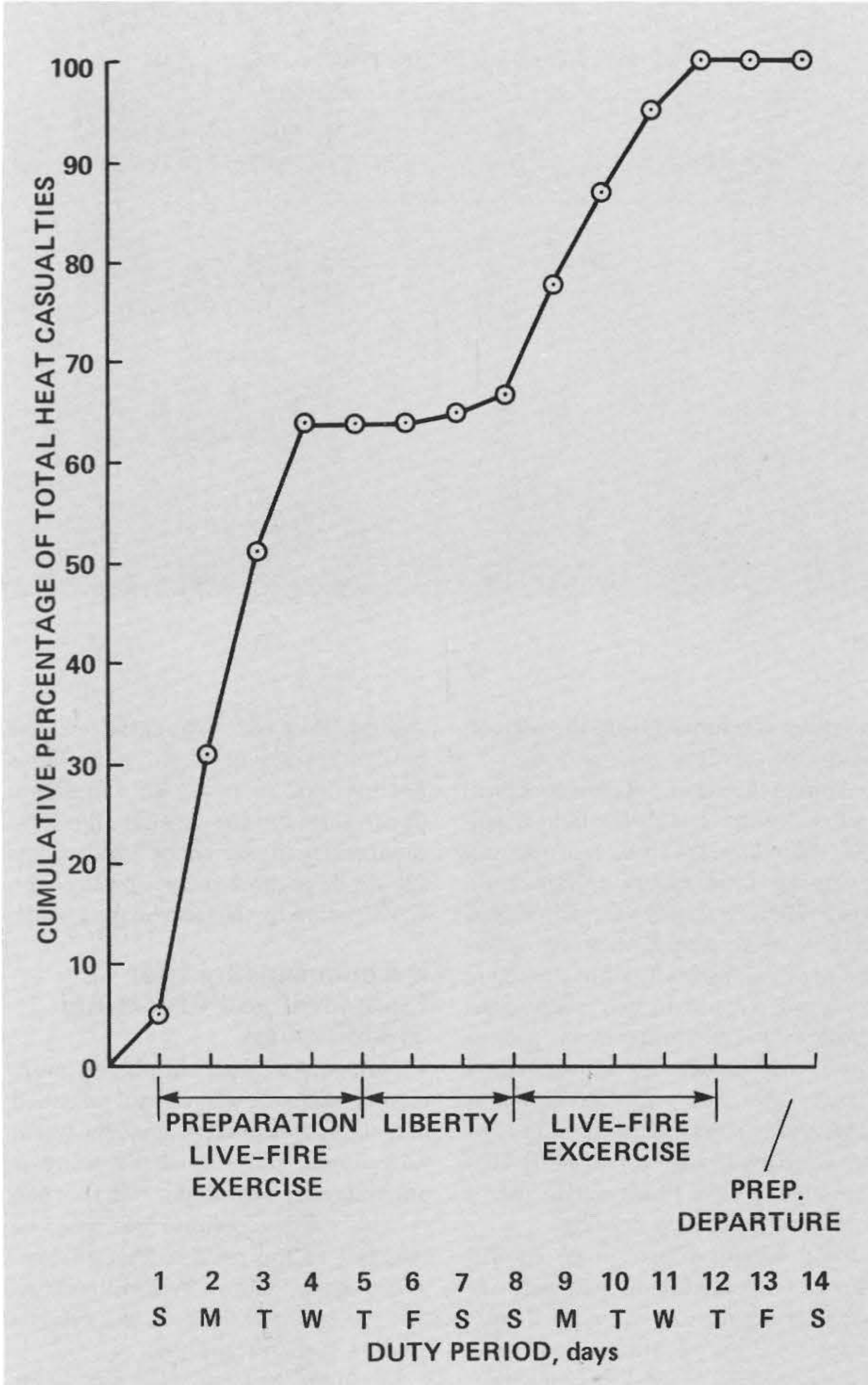

FIGURE 3. Cumulative percentage of total HRC's during the 14-day exercise period.

The field hospital and battalion aid stations should be equipped with battery-operated thermistor instruments for taking body temperatures. Currently, the aid stations and field hospitals are using mercury thermometers which must be kept cool in water or on ice. It is very difficult to obtain accurate body temperatures with these thermometers because the mercury starts climbing when the ther-

TABLE 11. Symptoms in HRC's (Percent of Total)

Symptoms	HRC 1979	HRC 1982	Combined HRC 1979 & 1982
Cramps	36	6	33
Nausea	51	41	50
Vomiting	20	23	20
Vertigo, Dizziness	52	41	50
Hot, sweating	26	29	26
Hot, dry	10	3	9
Headache	23	21	23
Cold, clammy	10	12	10
Unconscious	2	0	1

mometer is removed from the patient. Also, free mercury is hazardous.

Among the various Reserve medical units assigned to staff the field hospitals, there appears to be a propensity for using intravenous solutions on every HRC. Since the vast majority of HRC's (99 percent in these two exercise periods) were conscious, there are few good reasons to use intravenous solutions to rehydrate every patient when oral intake is considerably cheaper and safer. The exception is frank heat stroke with coma. Many of the nauseated and vomiting HRC's were able to take fluids orally after a brief period of spray cooling.

Field hospital personnel should plan to treat HRC's as their primary case load before arriving in the desert. As seen in Figure 3, almost two-thirds of the total HRC load occurred within the first 4 days, particularly during the June and July exercises. The last third of the total heat casualty load occurred during the 3 or 4 days of war-training exercise during the second week. Signs and symptoms reported as a percentage of the HRC are listed in Table 11.

Heat-stroke victims should be cooled rapidly, especially by the corpsmen in the field. The patient should then be evacuated to the branch hospital at Twentynine Palms Marine Base or to Camp Pendleton, depending on the branch hospital capabilities at the time. These plans should be organized early before each CAX period by the field hospital staff.

Recommendations for Equipment and Procedural Modifications

• Flax water bags should be more readily available and should be issued to troops in the deserts, since the warm water in the canteen usually becomes unpalatable. A more durable flax bag should be designed, one that could be attached to the pack or carried elsewhere out of the way. Warm water can then be transferred from canteens to the flax bags for cooling.

• At Camp Wilson's mess hall, most of the troops reported drinking about two to three small paper cups of fluid during meals. A larger cup, about pint size, may be an easy way to get the troops to consume larger quantities of fluids. Extra rations of fluids at meals should be encouraged and made readily available. The additional cost involved in the use of extra packaged fluid mixes is minor by comparison with the cost of one round-trip medical helicopter trip to Camp Pendleton or hospitalization of a few casualties.

• The black plastic 5-gal water containers, which carry the water for the tank crews and other groups, should be painted a lighter color to increase reflectivity, thereby keeping the water cooler.

• Since most tanks are not air-conditioned, interiors become very hot in a short time. The feasibility of installing small fans (particularly for the gunner and driver) should be considered. If the fans were directed toward the heads of the crewmembers, the likelihood of heat stress would be reduced and sweat would be kept out of their eyes. Additionally, there is a psychological effect of head cooling which reduces the error rate of mental calculations caused by overheating.(*7*) NASA has developed very small portable cooling units that can be connected to a conductive cooling vest (*10*) and cap.(*5,7*) These can be worn under the flak vests and helmets of tank crews. Such units could also be used to cool drinking liquids. With these additions, the tank crews could stay "buttoned up" much longer with respect to heat tolerance limits.

• The non-air-conditioned ambulances used in the field should be fitted with air scoops or windows that could be opened to cool the back area where the patients are carried. Small, oscillating recreational vehicle fans would also be useful in the patient area.

• Since most of the heat casualties occurred during noncombat tasks, such as cleaning details around the base camp, running wire, loading and unloading trucks and tanks, and setting up the base camp, serious consideration should be given to the design of uniforms. A military tropical/desert style of shorts could be worn during these tasks. The current green uniform is poorly designed for evaporative heat exchange and probably contributes significantly to the high rates of heat casualties that occur. British and Israeli troops, both of whom have engaged in considerable warfare in hot climates, have used tropical shorts for years.

• A personal desert handbook for each marine should be prepared and issued which provides information on drinking by a schedule, early warning symptoms and treatment of heat exhaustion and dehydration, work/rest cycles for maximum performance, both identification of poisonous snakes and arthropods, and first aid to be used if bitten. Other safety procedures, such as reporting unexploded ordnance, should also be included.

The loss of manpower through heat casualties is evident. However, attention should also be directed toward stemming the degradation of both physical(*2,4,9*) and mental(*6,8*) performance caused by exposure to heat and other stresses of desert exercises. In conclusion, results from these two field studies indicate that heat-related casualties were neither getting sufficient sleep nor drinking enough fluids—factors that reduce tolerance and performance during prolonged exposure to hot environments.

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In Memoriam

CAPT *Lamar R. Smith,* MSC, and his wife Yvonne died in an aircraft accident on 25 Feb 1984 in Princeton, WV.

Born in Stockdale, TX, on 18 July 1930, CAPT Smith received his B.S. degree in pharmaceutical science from the University of Texas in 1957 and an M.A. from the University of Arizona in 1971. He joined the Navy in 1951 and served in Korea with the Marine Landing Force. In 1964 CAPT Smith completed Officer Candidate School and served in Vietnam from 1967 to 1968.

CAPT Smith was a member of the American Society of Hospital Pharmacists, and in 1970 was admitted to the World Apothecary Association at the meeting in Canada. He was director of naval hospital pharmacies in Europe while stationed in Italy in 1974. In 1978 he was director of the Navy Pharmacy School in Portsmouth, VA, and in 1980 was the chief pharmacist stationed at the National Naval Medical Center, Bethesda, MD. His last assignment was at the Defense Personnel Support Center in Philadelphia as director of technical operations for the medical directorate.

CAPT Smith's decorations included the Presidential Unit Citation, the Navy Unit Commendation, the Meritorious Unit Commendation, Korea and Vietnam Service and Campaign Medals, and the Good Conduct Medal. In 1983 he received the

Meritorious Service Award. CAPT Smith was also voted Preceptor for the Howard College of Pharmacy.

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