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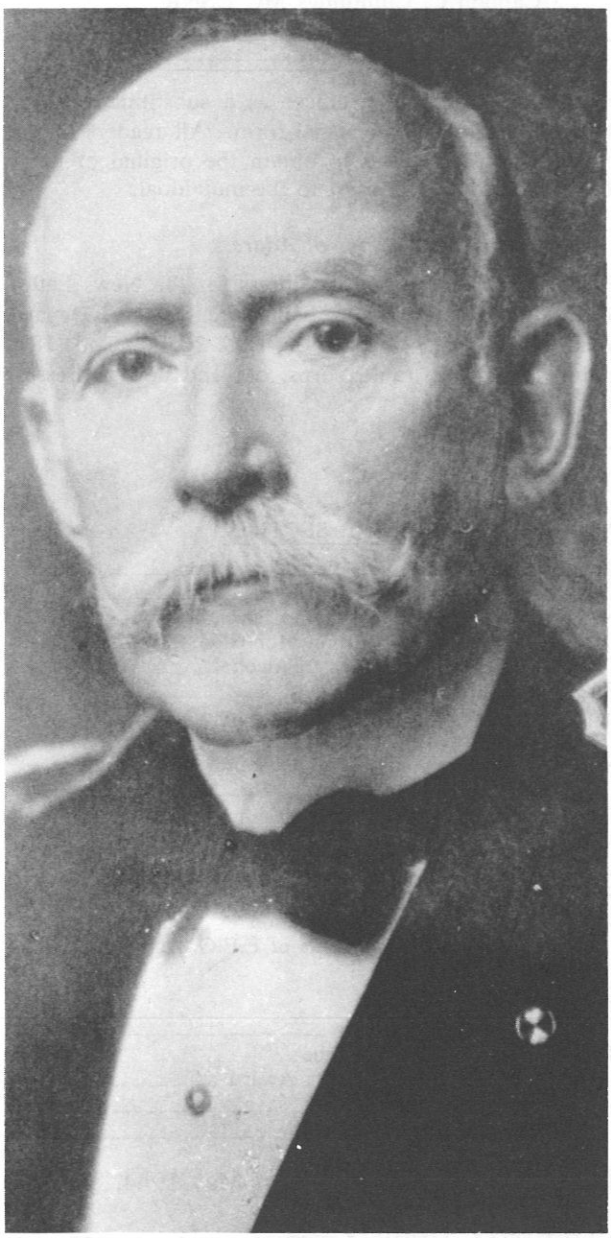

Surgeons General of the Past

(The fourteenth in a series of brief biographies)

James Rufus Tryon, the tenth Surgeon General and fourteenth Chief of the Bureau, was born in New York on 24 September 1837. He received his B.A. and M.A. degrees from Union College at Schenectady, and was graduated from the University of Pennsylvania Medical School in 1861. He was appointed Assistant Surgeon in the Navy from New York on 22 September 1863, being assigned to the West Gulf Squadron. From 1866 to 1870 Doctor Tryon served as an assistant to the Surgeon General. He was next with the Asiatic Station where he supervised a temporary smallpox hospital at Yokohama, Japan and directed construction of the Yokohama Naval Hospital in 1872, a structure destroyed by an earthquake in 1923. He had subsequent duty with the North Pacific Squadron, fought yellow fever at Pensacola, belonged to the Naval Examining Board at Philadelphia, and was a delegate to the International Medical Congress at Copenhagen, Denmark in 1884. He also became Fleet Surgeon of the newly built and famous White Squadron. Doctor Tryon was appointed Surgeon General of the Navy with the rank of Commodore 10 May 1893 by President Grover Cleveland, serving in that office until 1897. He revived and renamed the Naval Laboratory and Department of Instruction, for the postgraduate training of young medical officers, and established the Museum of Naval Hygiene. He emphasized naval medicine, hygiene and preventive medicine; advocated a medical supply depot; suggested establishment of a hospital corps; promoted construction of more hospitals; and proposed having more medical officers of higher rank. Fulfillment of his progressive ideas came in later administrations. Surgeon General Tryon was not only a man of superior vison but also popular in Washington society. He was retired from the Navy 24 September 1899 and died 20 March 1912.

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Policy

The U.S. Navy Medical News Letter is basically an official Medical Department publication inviting the attention of officers of the Medical Department of the Regular Navy and Naval Reserve to timely up-to-date items of official and professional interest relative to medicine, dentistry, and allied sciences. The amount of information used is only that necessary to inform adequately officers of the Medical Department of the existence and source of such information. The items used are neither intended to be, nor are they, susceptible to use by any officer as a substitute for any item or article, in its original form. All readers of the News Letter are urged to obtain the original of those items of particular interest to the individual.

Change of Address

Please forward changes of address for the News Letter to Editor: Bureau of Medicine and Surgery, Department of the Navy, Washington, D.C. 20390 (Code 18), giving full name, rank, corps, old and new addresses, and zip code.

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The issuance of this publication approved by the Secretary of the Navy on 4 May 1964.

HOW THE NAVY FIGHTS TUBERCULOSIS

LT George D. Hanzel MC USNR. Bulletin. National Tuberculosis Association 53(3):9-11, March 1967. (Permission for publication of this article has been obtained from the National Tuberculosis Association as it appeared in the Bulletin. The author, LT Hanzel, has added data in Tables I and II for 1966, which were not available at the time of the original publication—Editor.)

The prevalence of tuberculosis in the Navy is currently at a low level. But tuberculosis remains an important communicable disease wherever it appears. Since shipboard living may offer an ideal environment for the transmission of this highly infectious disease, the Navy Medical Department is acutely aware that tuberculosis is always a potential hazard to naval personnel.

The problem of tuberculosis in the Navy received wide press coverage in 1965 when cases occurred aboard the Boston and the Wasp. These two outbreaks were discovered because the Navy's Tuberculosis Control Program possesses a very sensitive detection system to identify potential outbreaks.

The Navy's System

How does the Navy's Tuberculosis Control Program work? All recruits entering a Recruit Training Center are skin-tested by the Mantoux technique using Purified Protein Derivative. At the same time they are skin-tested with histoplasmin and two antigens prepared from atypical mycobacteria. The testing at Recruit Training Centers is performed by nurses of the Operational Research Branch of the Tuberculosis Program of the U.S. Public Health Service. The skin-testing program for recruits began in 1948.

In addition, annual tuberculin skin tests were very recently made mandatory for all Navy and Marine Corps personnel. The advantage of such close scrutiny is obvious: Cases can be detected before they have a chance to progress to advanced disease.

All incoming recruits also receive chest X-rays. In addition, all Navy and Marine Corps personnel receive annual chest X-rays. This routine X-ray program began in 1944.

The use of annual skin tests and X-rays comprise the Navy's Tuberculosis Surveillance Program. When a case of active disease is identified by that program, the Contact Investigation Program is activated.

Whenever a case of active tuberculosis is discovered aboard ship, all members of the ship's crew are considered intimate contacts. They are therefore surveyed by means of skin tests and X-rays immediately and again at three months, six months and one year following the diagnosis.

Those men already known to be positive reactors are followed only with X-rays. Men with previous negative skin tests are followed with both skin tests and X-rays. Ten millimeters of induration is considered a positive test.

When an active case is discovered at a shore installation the actual intimate contacts are surveyed at the same time intervals as those aboard ship. The entire base is not surveyed, any more than a whole town is surveyed because of one civilian case.

All personnel identified as converters (this also applies for converters found on yearly routine testing) are admitted to the nearest Navy medical facility for three days. Here, three cultures are made of sputum specimens, as well as cultures of gastric washing specimens, three direct sputum smears, and 14 x 17 chest X-rays. History is taken and physical examination made, along with routine laboratory studies.

If smears, X-rays, and the rest are normal at the end of the three days, the cultures are incubated and the converter is sent back to full duty on 300 milligrams of isoniazid daily for one year. While on isoniazid the patient receives 14 x 17 chest X-rays every three months. He receives yearly X-ray examinations for four years following termination of isoniazid.

When an active case is detected during the three-day hospitalization, the patient is transferred for

definitive therapy to the Naval Hospital at either St. Albans, New York, or San Diego, California. The Tuberculosis Control Section of the Bureau of Medicine and Surgery is notified of all cases of active tuberculosis by a special epidemiological report.

As a result of this thorough hospital examination of converters, many cases are detected while still in a very early stage of disease. In this respect the Navy program is superior to most tuberculosis control programs, since it has the ability to hospitalize converters.

This point should be stressed. The program as now operating is so sensitive that it is identifying disease that would have been missed in the past. Previously, some men may not have been diagnosed until after discharge from service. The program has become more effective, and therefore it looks as though there is more tuberculosis in the Navy now. This increased incidence is relative (the result of superior case finding) rather than absolute.

Naval Recruit Rates

The overall positive tuberculin reactor rate among recruits entering the Navy has been between 3.5 percent and 4 percent for the past five or six years. Such a low reactor rate lends itself to a control program using skin-testing and isoniazid prophylaxis for converters.

Speaking of the skin-testing program for naval recruits, it is widely known that much of the data that first pointed out the significance and geographical distribution of atypical mycobacterial infections were gathered in that program. The analysis of the data was done by Doctors Carroll Palmer and Lydia Edwards of the Public Health Service. These two researchers, using Navy recruits as subjects, are still gathering valuable information on various facets of tuberculin sensitivity.

The Navy tuberculosis incidence rate has dropped markedly over the most recent 10-year period. The apparent increase in the last three years, as explained above, is the reflection of a more sophisticated case-finding technique and not an absolute increase. The Navy statistics for the years 1963 to 1965 make an interesting comparison with those for the United States as a whole furnished by the U.S. Public Health Service, as shown in Table I. As noted, the figures indicating a rise point up the increased sensitivity of the Navy's tuberculosis detection program.

TABLE I

INCIDENCE OF TUBERCULOSIS CASES PER 100,000

Population	1963	1964	1965	1966
Navy	16.3	20.1	26.5	24.9
United States	28.5	26.6	24.8	—

The incidence of tuberculosis in the Navy during the past three years and the distribution according to stage of disease are presented in Table II.

The bulk of the increase in cases can thus be seen to be among those with minimal involvement. Without a highly sensitive detection program many of them would have been missed. The advantage of early diagnosis is obvious: There is much less chance of transmission of the disease by a minimally involved individual.

The Two Outbreaks

Let's look at the tuberculosis outbreaks aboard two Navy vessels that attracted so much publicity in 1965.

The first outbreak occurred aboard the guided missile cruiser Boston (CAG–1), of which the total complement is about 1,200 men. The index

TABLE II

DISTRIBUTION OF TUBERCULOSIS ACCORDING TO STAGE OF DISEASE

YEAR	MINIMAL		MODERATE		FAR ADVANCED	
	Number	Percent of year's total	Number	Percent	Number	Percent
1963	66	46.2	65	45.4	12	8.4
1964	108	61.0	56	31.6	13	7.4
1965	161	68.8	62	26.5	11	4.7
1966	192	77.1	49	19.7	8	3.2

case of tuberculosis was detected on a routine yearly X-ray in May 1964. The senior medical officer of the ship, after consultation with the Tuberculosis Control Section of the Bureau of Medicine and Surgery, immediately instituted the kind of control program described above, except that only intimate contacts were followed.

A second case was discovered in the following month as a result of the examination of contacts. Decontamination procedures were then carried out aboard the ship. These consisted of extensive cleaning and disinfecting, repainting of the berthing compartments of the men with active cases, and replacing filters in the ventilation.

No new cases were found until one turned up in March of 1965. This third patient had been in contact with the first case discovered in 1964. The new patient had a right lower lobe cavity and a heavily positive sputum smear. When these findings were transmitted to the Tuberculosis Control Section, it was decided that the entire ship's company should be followed. This new program was begun in April 1965. All converters were studied with sputum cultures, X-rays, and all the rest. The last case from the Boston was reported in October 1965. The follow-up studies terminated in the summer of 1966.

The box score of cases from the Boston is as follows:

FAR ADVANCED	1
MODERATE	3
MINIMAL	19
CONVERTERS ON INH	224

The Story of the Wasp

The second ship involved in a tuberculosis outbreak was the aircraft carrier Wasp (CVS–18), of which the total complement is about 3,500. Although fewer cases were involved, the outbreak drew more publicity because the Wasp was the prime recovery vessel for a Gemini space shot.

The first case was discovered in August 1965 when a Chief Petty Officer appeared for a routine preretirement chest X-ray. This film showed an extensive left upper lobe cavity. The man's sputum was markedly positive for acid-fast bacilli. The man had already been detached from the ship, so when the Tuberculosis Control Section was informed of the case the ship was immediately notified by telephone.

A contact study to include the entire ship's crew was initiated at once. No new cases have been detected since December 1965. The follow-up studies terminated in the fall of 1966.

A box score of the results of the Wasp study shows:

FAR ADVANCED	2
MODERATE	1
MINIMAL	5
CONVERTERS ON INH	117

An interesting footnote to all of this is that the four men flown off the Wasp "because of tuberculosis" two days before the Gemini splashdown, an event that elicited nationwide publicity, were all shown to have been infected with Runyon Group II atypical mycobacteria—*not* M. tuberculosis. This fact is not generally known.

Many people have asked, "How did the Navy miss these men until the vessel was out on the recovery mission?" Because of the slow-growing properties of the tubercle bacillus, cultures may take four to six weeks to become positive. Such was the case with the patients from the Wasp. They were identified as converters and admitted to the Chelsea Naval Hospital in late October. All immediate examinations were negative, so their cultures were planted and they were returned to duty aboard ship on isoniazid prophylaxis. The cultures were not read as positive until the vessel was underway on the Gemini recovery mission.

A TB Control Victory

Obviously, the outbreaks on these two vessels were not epidemics of "galloping consumption" that decimated the crew and left the remaining men pulmonary cripples. These two situations became "outbreaks" only because a sensitive control program recognized a potential source of infection and identified cases with only minimal involvement. With a less sensitive system, many of these cases would have passed unrecognized and the chain of infection would have spread.

This then is the story of tuberculosis control in the Navy, and the role that an aggressive program plays in the control of a disease that has always been a scourge to sailors.

George D. Hanzel MD has been, since 1965, head of the Tuberculosis Control Section, Preventive Medicine Division of the Bureau of Medicine and Surgery, Department of the Navy. A graduate of the University of Pittsburgh School of Medicine, Dr. Hanzel was commissioned a lieutenant in the Medical Corps, U.S. Navy, in 1961.

SALINE FRONTAL LOBOTOMY IN THE TREATMENT OF INTRACTABLE PAIN

Paul Gutterman MD and Henry A. Shenkin MD,
JAMA 199(13):977-979, March 27, 1967.

Prefrontal saline lobotomy was performed for intractable pain in 20 patients. Satisfactory results were obtained in 15, with a follow up in some approaching one year (average three months). One patient died of intracerebral bleeding and two patients remained stuporous until death. Among survivors, there were only transient changes in personality and no serious psychiatric complications. Prefrontal saline lobotomy is preferred to other methods of lobotomy because it does not require special equipment and is relatively safe and effective.

Frontal lobotomy can offer relief from severe, intractable pain, especially when the pain is too diffuse for specific denervation to be effective. This procedure is particularly applicable to patients suffering from terminal cancer because it may provide relief from the anxiety of imminent death and from narcotic addiction. On the other hand, the effectiveness of lobotomy is not generally long lasting and the usual procedures may result in personality change that is too extensive.

The objection that lobotomy gives only several months of relief is generally inapplicable for patients with terminal cancer. With regard to the objection that the effects of lobotomy are unpredictable, we have found the fractional injection of saline into the frontal lobes, to be a suitable answer. In the past few years prefrontal saline lobotomy has been carried out on 20 patients with generally satisfactory results, and this experience is the basis for this communication.

Methods

All medications for pain are discontinued at least 12 to 24 hours prior to surgery, and no narcotics or heavy sedation is used for premedication. After local anesthetization of the skin, bifrontal burr holes are made just anterior to the coronal suture and approximately 3 cm from the midline. A ventricular cannula is inserted perpendicularly until the floor of the anterior fossa is encountered. Should the ventricular system be dilated and the cannula enter the ventricle, it is withdrawn and directed more anteriorly. Fifteen cubic centimeters of saline are first injected on the dominant side, beginning approximately 1 cm above the orbital plate and continuing injection as the needle is withdrawn. If the patient still complains of pain, the same procedure is repeated on the opposite side. The saline is injected fractionally until relief of pain is obtained or until 15 cc are injected on the nondominant side. If pain relief is not obtained, the additional effects of the edema produced by the procedure are assessed during the next 48 hours. If pain persists after 48 to 72 hours, the injection is repeated under sterile conditions at the bedside. Reinjection was necessary on only two occasions.

From the Department of Neurosurgery, Episcopal Hospital, Philadelphia.

TABLE 1.—RESULTS OF SALINE FRONTAL LOBOTOMY

Condition	No. of Patients	Percentage
Excellent	2	10
Good	13	65
Fair	2	10
Poor	0	0
Stuporous, but free of pain	2	10
Died	1	5
Total	20	100

Results

Results were classified in the following manner: *Excellent*—relief of pain, anxiety, and addiction; patient does not complain of pain even when asked. *Good*—relief of addiction, anxiety, and suffering; patient complains of pain when asked. *Fair*—temporary or incomplete relief of pain and suffering. *Poor*—no relief of pain or suffering (Table 1).

All patients were observed to the time of death, three days to ten months, except one patient who was lost to follow up after ten months (Table 2).

TABLE 2.—INDIVIDUAL PATIENT DATA

Patient	Age	Sex	Diagnosis	Side Effects	Effect on Pain*	Length of Follow Up
1	58	M	Cancer of bladder with metastasis	Stuporous until death	. . .	5 days to death
2	42	F	Cancer of breast with metastasis	Dull, 2 days	Good	3½ months to death
3	48	F	Chronic pancreatitis	None	Good	10 months; lost to follow up
4	65	M	Cancer of thyroid with metastasis	None	Good	10 days to death
5	62	M	Cancer of lung with metastasis	None	Good	3 days to death
6	53	F	Cancer of lung with metastasis	Dull, 5 days	Good	9 days to death
7	51	F	Cancer of ovary with metastasis	None	Excellent	9 months to death
8	66	M	Cancer of ureter with metastasis	None	Good	9 months to death
9	48	F	Multiple myeloma	Dull, 4 days	Good	1 month to death
10	66	F	Intractable thoracic pain, etiology unknown	Died from intracerebral hematoma	. . .	5 days to death
11	38	F	Cancer of breast with metastasis	None	Good	10 months to death
12	56	M	Cancer of lung with metastasis	Dull, 4 to 5 days	Excellent	1 month to death
13†	69	M	Cancer of prostate with metastasis	Agitated, 5 days	Fair	Pain recurred in 5 months; died ½ month later
14	76	M	Cancer of neck with local spread	Stuporous following injection	. . .	1 month to death
15	60	F	Cancer of lung with metastasis	None	Fair	Pain recurred in 2 months; died 8 months later
16	63	M	Cancer of kidney with metastasis	None	Good	15 days, lost to follow up
17	68	M	Cancer of lung with metastasis	None	Good	1 month to death
18	49	F	Cancer of breast with metastasis	None	Good	5 months to death
19	46	M	Malignant melanoma	None	Good	9 days to death
20†	69	F	Cancer of stomach with metastasis	None	Good	2 weeks, still living

* See text for classification.

† These two patients received additional injections.

Results of two operations were classified as excellent, and results of 13 as good. Two patients had temporary relief for two and five months, respectively. Two other patients, both with large lateral ventricles, remained stuporous following injection for 5 and 30 days, respectively, and one patient died postoperatively due to cerebral hemorrhage.

There were no seizures or focal neurological changes. Four patients exhibited mental dullness for two to five days. One patient was treated with chlorpromazine because of agitation for several days. All patients were relieved of anxiety and showed improvement in appetite and outlook for the future. None required narcotics postoperatively although all received large amounts prior to lobotomy. The two patients who had recurrence of pain at two and five months, respectively, were not returned to our care and were given narcotics until their deaths. There was no evidence of withdrawal symptoms in any patient.

Two patients did not have terminal malignancy. One had been incapacitated for two years with pain of unknown etiology, and died of cerebral hemorrhage. The other had chronic pancreatitis and narcotic addiction relieved by the procedure.

Case 10 (EH 245–208).—This 66-year-old woman had thoracic pain on the left for two years. Pulmonary, cardiac, gastrointestinal, and urological evaluations failed to reveal the cause. Six months prior to admission, a posterior rhizotomy was performed elsewhere, with good analgesia in the affected area but without relief of pain. The pain increased in severity. She was given large doses of narcotics over a prolonged period and became markedly agitated. After reevaluation and psychiatric observation, saline lobotomy was carried out. One hour following surgery the patient became unresponsive and multiple ecchymotic areas appeared over the entire body. Craniotomy was performed and an intracerebral hematoma was evacuated, but the patient failed to regain consciousness. Several hours later there was upper gastrointestinal bleeding. She died five days postoperatively.

This was the only episode of intracranial bleeding in this series. Because of the multiple sites of bleeding, a coagulation defect was suspected but studies failed to reveal any abnormality.

Case 1 (EH 246–723).—This 58-year-old man was dying of carcinoma of the bladder with diffuse metastases. He was bedridden, quite dull mentally, and slightly confused but still required large doses of narcotics. At operation the ventricles were large. Both frontal lobes were injected with 15 cc of saline. Postoperatively, he remained stuporous and survived for only five days.

Case 14 (EH 261–471).—This 76-year-old man was admitted with intractable facial and arm pain secondary to metastatic carcinoma. He was somewhat confused, disoriented, and complained of intense pain. At surgery, large ventricles were encountered. Following several attempts, the cannula was passed far anteriorly to avoid the ventricle and injection carried out bilaterally. Although relieved of pain, the patient remained semistuporous for the remainder of his life (30 days). No evidence of subdural or intracerebral hemorrhage was found on postmortem examination.

There are two possible explanations for the poor results in these two cases. First, both patients were mentally dull, possibly implying cerebral disorder. Second, both patients had large ventricles, possibly implying cerebral atrophy. Nevertheless, the usual amount of fluid was injected. A more cautious approach in these circumstances would seem to be indicated, either to discontinue the procedure or to use less saline.

Comment

Freeman and Watts reported in 1946 that somatic pain could be alleviated by prefrontal lobotomy. They particularly noted that fear and anxiety were relieved. Others reported excellent relief of pain and addiction. Some, however, criticized this method because of deterioration of personality, impaired judgment, and antisocial behavior in some patients.

Scarff described relief of pain by unilateral prefrontal lobotomy. Results were good in 66 percent and fair in 20 percent of 58 patients with no significant impairment of intellect or personality. Other reports of the unilateral procedure were less favorable because relief was short-lived and there were personality changes.

Pool initiated topectomy in 1946, and LeBeau used this operation for relief of pain in 25 patients in 1950. Results were good in over 75 percent but there were two deaths, two cases of seizures, and one case of aphasia. There were temporary personality changes in 66 percent. Levine et al noted better relief of anxiety and fewer psychiatric disturbances with restricted bimedial lobotomy, but the incidence of seizures and sphincter disturbances was greater.

These modifications of the standard lobotomy seemed to offer little improvement over the original procedure with regard to desired results or avoidance of side effects. Further, all of these methods are relatively stressful surgical procedures for debilitated patients.

Williams and Freeman used transorbital lobotomy with local anesthesia. There was little personality change but relapse to the painful state occurred within two weeks in five of 23 patients, and there were two deaths, one due to intracranial hemorrhage.

Grantham and Spurling introduced fractional lobotomy by electrocoagulation. Results were satisfactory in 73 percent of patients with a relatively long survival period (3 to 43 months). Serious psychiatric problems and seizures did not occur. White et al modified the procedure by using implanted electrodes which could be activated while the patient was alert. Relief of pain was satisfactory without personality deterioration or seizures. Herzberger and Brahan also reported satisfactory results with electrocoagulation by a transorbital approach. Electrocoagulation lobotomy seems to be a successful and benign procedure but involves specialized and expensive equipment.

Bridges and Liss described prefrontal fractional saline lobotomy in 1958. Through bilateral burr holes they injected an average of 15 cc of saline 24 to 48 hours postoperatively, repeating daily or weekly injections until relief was obtained. They presented 12 cases with a follow up to three months, and additional cases of patients who died within 30 days, and reported satisfactory results with no postoperative deaths, seizures, or personality changes. Llewellyn and Wilson described satisfactory results in all 16 patients treated with the same method, but with an average survival of only six weeks. Eight patients required reinjection within 30 days. No untoward personality changes or seizures were noted.

Satisfactory relief of pain was obtained in 15 of our 20 patients, but there were three operative deaths. Six patients had satisfactory relief of pain for more than five months; one patient for ten months. Most patients showed greater interest in their surroundings, with marked relief of anxiety. Appetite improved, and several patients gained weight and became more active, perhaps because the heavy narcotic intake was interrupted. There were no additional neuropsychiatric complications.

The ease of the procedure should be stressed, both for the patient and the surgeon. It is performed using local anesthesia and can be carried out within 20 to 30 minutes. If the original pain returns, or if the initial procedure is unsuccessful, repeated injections can be carried out at the bedside. Indeed, it is feasible to perform this procedure in any hospital since no specialized instrumentation is necessary.

(The references may be seen in the original article.)

DETECTION OF OSSEOUS METASTASES EVALUATION OF BONE SCANNING WITH STRONTIUM-85

Russell C. Briggs MD, Cancer 20(3):392–395, March 1967.

A 3-year experience of bone scanning with strontium-85 in a series of 88 patients with known malignant disease is reported. Evidence of altered osseous metabolism was noted in 47 of 83 cases suitable for study. Confirmation of positive results was obtained in 34 (72 percent) of the 47 cases. One false negative examination was recorded. All studies were performed because of uncertainty of integrity of at least a portion of the skeletal system. Current indications for scanning with strontium-85 in malignant disease are presented. The method appears applicable to selected cases both before definitive treatment and after dissemination of disease has been established.

In the past 5 years numerous reports have appeared attesting to the fact that strontium-85 (^{85}Sr) is of value in detecting a variety of lesions of bone, both benign and malignant. Appelgren et al. have utilized autoradiographic methods to show that the most active foci of ^{85}Sr deposition in osteosarcomas occurred in well-developed mineralized trabeculae. Simpson and Orange, also using autoradiography,

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The author thanks Drs. G. W. Wirtanen and J. C. Kline for their contributions to the scintiscanning program.

have demonstrated ^{85}Sr deposition in metastatic tumors to bone to be in areas of new bone formation.

Confirmation of positive scintiscan findings, particularly in conjunction with negative roentgenograms, often is a difficult task. Charkes and Sklaroff used the bone biopsy to surmount this problem in several of their early cases; however, bone biopsy is difficult to obtain in large series of cases and these authors pointed out that for long range studies subsequent roentgenographic follow-up for substantiation of scintiscan findings would be a valuable tool. To date, only the series of 65 cases presented by Simpson and Orange using a whole body scanner has attempted to provide adequate long term data by the method which would appear to be most reasonable, i.e., roentgenographic follow-up. The purpose of this communication is to present the results of scintiscanning with ^{85}Sr in a series of 88 patients with known neoplastic disease and to correlate information, which has subsequently become available, with the positive localization obtained by scintiscanning.

Methods and Materials

In the interval between February 1963 and February 1966 a total of 88 patients with known malignant disease were referred to the radioisotope section of the University of Wisconsin Hospitals for bone scanning with strontium-85. Of these, 83 cases were suitable for analysis. Studies were incomplete in 5 cases. All patients received a standard dose of 100 μc of ^{85}Sr as $SR(NO_3)_2$ administered by vein. The patients were scanned on one or more occasions from 2 to 7 days after injection. The maximum number of examinations of any single patient was 4.

All scanning procedures were performed on a commercially available unit* with a 3 x 2 inch sodium iodide scintillation crystal and a 7-hole collimator constructed in our laboratory. Both dot scans on paper and photoscans on roentgen-ray film were obtained in all instances. Areas scanned were those questioned on the basis of clinical and roentgen studies and those localized by manual scanning.

The historical information of each case was obtained from the hospital, tumor clinic and radiotherapy records. Pertinent roentgen films were reviewed as were the individual scintiscan findings.

The interpretation of scintiscan findings on study with ^{85}Sr is based on knowledge of the distribution of the radiopharmaceutical in the normal patient. Final conclusions are aided by the clinical history and physical findings, accurate surveillance of roentgenographic studies, comparison of symmetrical or similar areas of the skeleton on the scans and familiarity with the characteristics of the scanning device.

Results

The 83 cases reviewed had malignancies arising from 22 different sites. Of these patients 47 had evidence of one or more sites of abnormal focal accumulation of ^{85}Sr demonstrated by scintiscanning. The distribution by site of primary tumor is shown in Table 1. Thirty patients (36.14 percent) had primary carcinoma of the breast. Only one patient presenting with Ewing's sarcoma, had a primary neoplasm of bone. All of the patients with primary carcinoma of the bladder (5) had positive studies but this is considered fortuitous. One of the 36 cases with negative scans had definite roentgen evidence of metastatic disease at the time of scintiscanning.

TABLE 1.

Site of origin	Results	
	Pos.	Total
Breast	21	30
Lung	8	13
Colon	3	8
Bladder	5	5
Cervix	1	4
Hodgkin's disease	2	3
Prostate	2	3
Kidney	0	2
Lymphoma	0	2
Miscellaneous (13 sites)	5	13
Total	47	83

TABLE 2. PRIMARY REASONS FOR BONE SCAN (83 Cases)

Scan result	Pain	Extent of disease	Confirm x-ray findings
Positive	18	17	12
Negative	26	5	5
Totals	44	22	17

Table 2 reveals the primary reasons for ^{85}Sr bone scanning in the 83 patients evaluated. There ap-

* Picker Magnascanner III, Picker Nuclear Corporation, White Plains, N.Y.

peared to be 3 particular reasons for performing the study:

Pain—present in nearly all patients but a primary indication for scanning in only 44 (53 percent) cases.

Desire for more accurate knowledge of extent of disease to osseous system—the motivating force in 22 instances (26 percent).

Confirmation of equivocal roentgen findings—the indication for bone scanning in 17 cases (21 percent).

Each of the 3 indications for bone scanning reflected uncertainty on the part of the referring physician with respect to the integrity of at least a portion of the osseous system.

Of 47 cases with positive bone scans 18 had identical scan and roentgenographic localizations of osseous metastatic lesions. In 17 the scan was positive in the presence of negative roentgenograms while in 12 cases the extent of disease shown by scanning was greater than seen roentgenographically (Table 3). In the 21 positive cases with carcinoma of the breast 11 (52 percent) had bone scans which provided information not available on conventional roentgenographic examinations performed on or about the same dates as the radioisotope procedure (Table 4).

Table 3 also illustrates the various methods of confirmation of the positive scintiscan findings. Definitive proof of positive localization with ^{85}Sr

TABLE 3. POSITIVE ^{85}SR BONE SCANS (47 Cases)

Method of confirmation	Scan and x-rays identical	Scan positive x-ray negative	Scan showed greater extent of disease
X-ray at time of scan	18	0	0
Subsequent x-ray	0	7	4
Biopsy	0	2	2
Postmortem	0	1	0
Deceased, no follow-up	0	2	4
Living, status undetermined	0	5	2
Totals	18	17	12

TABLE 4. CARCINOMA OF BREAST

Positive ^{85}SR bone scans	21 cases
Scan and x-rays identical	10
Scan positive, x-ray negative	7
More bone disease on scan	4
Total	21

scintiscanning was obtained in 34 of 47 cases (72 percent). Six patients died before further follow-up methods could be implemented while 7 individuals are alive but have been unavailable for subsequent study.

Discussion

In most cases the dissemination of tumor cells to the skeleton is via nutrient vessels and these cells tend to settle in the spongiosa rather than in dense compact portions of bone. Only rarely is there involvement of periosteal vessels. Since spongy bone forms a wide meshwork of thin trabeculae, its roentgenographic image is much less dense than that of compact bone. Lesions in the spongiosa thus may be difficult to visualize on conventional roentgen examination. This has been substantiated experimentally by Borak. This point is of particular importance in the search for skeletal metastases in vertebrae, ribs, pelvis and the metaphyseal portions of long bones. Therefore, a method for more accurate assessment of skeletal integrity appears desirable.

The results in this series substantiate the fact that bone scanning with ^{85}Sr does improve upon the roentgenographic method of detection. This is borne out by the fact that in 29 of the 47 cases (62 percent) with positive bone scans new or additional information was achieved. The scan findings were confirmed in 72 percent of cases in this study which compares favorably with the figure of 70 percent of cases with osseous metastases in the series reported by Simpson and Orange using whole body scanning.

The problem of the false negative scan must be contended with in evaluating the usefulness of the bone scan. In this series one of 36 patients with normal bone scans had progressive roentgenographic manifestations of skeletal metastases. This patient had a primary carcinoma of the ureter. Other investigators have reported the simultaneous existence of osseous metastases and negative bone scans in occasional cases of breast carcinoma, reticulum cell sarcoma and myelomatosis. The incidence of false negative bone scans appears to be less than 5 percent.

The actual mechanism of the false negative scan seems related to the response of the individual bone to tumor invasion. Milch and Changus have attempted to grade the relative proportions of bone-destroying and new bone-forming elements in skeletal metastases by histologic study. They noted that tumors from a variety of sites may produce little or no osteoblastic response. Since visualization of a lesion by ^{85}Sr bone scanning is dependent on active response of this type, the occasional absence of uptake may occur.

Unfortunately, ^{85}Sr has several disadvantages as a scanning agent. These have been pointed out by Charkes et al. and include: (1) long physical half-life (64 days), (2) high radiation absorbed dose to bone, (3) slow fecal excretion, (4) studies over a 3 to 7 day period and (5) AEC approval for study of malignancy only. Consequently, evaluation of other radionuclides, particularly strontium-87m, fluorine-18, and gallium-68, as potentially feasible bone scanning isotopes for clinical use, are being investigated in this laboratory, as well as by others.

Conclusions

The results of this study confirm the usefulness of bone scanning with strontium-85 in the detection of skeletal metastases before roentgenographic changes occur and when the extent of skeletal involvement is uncertain. Indications for the procedure in malignant disease based on our experience and that in the literature is as follows:

Prior to definitive treatment

1. Primary malignancy of bone
2. Any malignancy with pain and negative x-rays

In long term follow-up

1. Skeletal pain and negative x-rays
2. Assessment of extension to and through skeleton

Portal boundaries for radiation therapy

1. Younger patients
2. Uncertainty of margins in any patient

Scanning with strontium-85 is applicable to treatment planning in patients with primary bone tumors to determine both areas of local extension of tumor and the presence of other sites of skeletal spread. This has been confirmed by a case of Ewing's sarcoma in this series and by a case of osteogenic sarcoma reported by Charkes et al.

The usefulness of the procedure in the patient with known malignant disease complaining of skeletal pain is apparent. Extension of usage to include those with probable malignancy complaining of skeletal pain prior to definitive radical treatment would appear justifiable; however, because of the significant absorbed dose of radiation to bone incurred by repeated studies, serial scanning with strontium-85 for detection of osseous spread in the asymptomatic patient with known malignancy does not appear warranted.

The determination of portal boundaries for radiation therapy is considerably important in the child and young adult since preservation of growth and function deserve consideration along with inclusion of disease. If there is osseous involvement, bone scanning has a definite role in the balance of adequate treatment and survival of normal tissue. The procedure also proved useful in this series for correction of portal margins in several instances, particularly if there had been no other objective evidence of bone disease.

A thorough evaluation of bone scanning in staging of malignant disease prior to treatment should be undertaken. At this time, it is thought that such a study would be feasible using the short-lived nuclides mentioned previously and a whole-body scanning system. The eventual use of retention studies in conjunction with whole body counting may be even more accurate, but probably more time consuming. Improvement of current methods of treatment planning in several malignant diseases might follow improvements in staging.

(The references may be seen in the original article.)

CORTICOSTEROIDS AND PEPTIC ULCER: IS THERE A RELATIONSHIP?

Allan R. Cooke MB BS MRACP, Amer J Dig Dis 12(3):323–329, March 1967.

There is unequivocal evidence that corticosteroids cause gastric ulceration in the rat and in the dog. The frequent concurrence of peptic ulcer and corticosteroid therapy—one a disease seen frequently; the other a common form of therapy—has led to the widespread impression that corticosteroids increase the incidence of peptic ulceration in man. The validity of this impression has been questioned recently.

It is the point of view of this reviewer that the evidence published to date is so fragmentary that it is difficult to draw any conclusions. The vast majority of the studies are retrospective and thus underestimate the incidence of peptic ulceration. The few prospective studies done are subject to criticism. These will be discussed in detail.

In order to ascertain whether corticosteroids cause peptic ulceration it is necessary to know the incidence of the disease in the community. The definitive study of this type was done by Doll and Jones for a sample population living in London. They found that the incidence in this group between the ages of 15 and 64 years was 5.8 percent for men and 1.9 percent for women. Ivy *et al.* in a survey of the literature stated "from 5 to 10 percent of most populations develop an ulcer in a lifetime, that the total incidence of those affected at any one annual survey will vary from 1 to 3 percent of the population above 20 years of age. . . ." Although these estimates give some idea as to the frequency of peptic ulcer in the general population, neither study indicates the frequency in patients with various chronic diseases—e.g., rheumatoid arthritis, ulcerative colitis, or collagen diseases. Since these are diseases in which corticosteroids are commonly used it is important to know how common peptic ulceration is in these conditions. Estimates of the frequency of peptic ulceration in various chronic diseases have been little better than guesses. In rheumatoid arthritis before the introduction of corticosteroids, Bauer estimated that 4.5 percent of 650 patients with rheumatoid arthritis had peptic ulceration. Ragan's estimate was 6–8 percent. For 830 patients with rheumatoid arthritis assessed in 1947 at the Mayo Clinic it was found that 3.3 percent had a peptic ulcer. During the period 1954–1957 at the same clinic, an incidence of 8.1 percent was reported for 877 rheumatoid-arthritis patients not receiving corticosteroids. Whether this change was due to increasing frequency or to better diagnosis is pure speculation. These reports may indicate the frequency of peptic ulceration occurring in special groups of patients reporting to clinics for assessment and treatment of their disease, but gave no indication as to the overall frequency of either the disease or associated peptic ulceration in the general population. With these difficulties in mind the evidence relating peptic ulceration and corticosteroids will be considered under the following categories: (1) retrospective studies in patients with diseases other than rheumatoid arthritis; (2) retrospective studies in rheumatoid arthritis; and (3) prospective studies.

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Retrospective Studies

Patients With Diseases Other Than Rheumatoid Arthritis

Sandweiss, in a literature survey, gathered 980 patients with various diseases who were receiving corticosteroids for short or long periods; he found 34 new or reactivated peptic ulcers, an incidence of 3.5 percent.

In asthma, ophthalmic diseases, various allergic disorders, dermatoses, malabsorption syndrome, ulcerative colitis, and various pediatric conditions there was no apparent increase in the incidence of peptic ulceration. In very few instances was a peptic ulcer reported (Table 1). All these studies were retrospective so that the incidence of peptic ulceration was probably underestimated. Although the incidence of ulcer in these series was low, no conclusions are justified on the basis of these reports since no control groups of any kind were studied.

TABLE I. INCIDENCE OF PEPTIC ULCERATION IN NONRHEUMATOID PATIENTS TREATED WITH CORTICOSTEROIDS

Type disease	*No. patients*	*No. ulcers*	*Incidence (%)*	*Author*
Asthma	75	0	0	Arbesman & Richard, 1954
Ophthalmic	66	0	0	Gordon, 1959
Allergies	590	1	0.2	Rose *et al.*, 1959
Dermatoses	254	0	0	Goldman, 1959
Malabsorption syndrome	33	0	0	Adlersberg, 1957
Ulcerative colitis	109	0	0	Truelove & Witts, 1955
Ulcerative colitis	52	0	0	Zetzel & Atin, 1958
Ulcerative colitis	180	1	0.5	Kirsner *et al.*, 1957
Pediatric conditions	340	4	1.1	Good *et al.*, 1957
TOTAL	1,699	6	0.3	

Patients With Rheumatoid Arthritis

As pointed out previously, the incidence in rheumatoid arthritis is unknown and estimates varying between 3.3 percent and 8 percent have been reported. There is evidence that the incidence is possibly increasing.

In the reports reviewed (Table 2) the incidence of peptic ulcer in rheumatoid arthritis varied from 0 percent to 38.4 percent. In all studies, with the exception of that of Kern *et al.*, virtually no attempt was made to assess the role of other potentially ulcerogenic drugs such as phenylbutazone or acetylsalicylic acid. In nearly all reports the possibility of peptic ulcer was assessed along with other obvious complications of corticosteroid therapy and thus not specifically investigated. Very few patients in any series had radiologic studies or endoscopic examinations performed. Rarely was a pretreatment control X-ray carried out.

The study by Kern *et al.* is undoubtedly the most informative. In 169 patients with rheumatoid arthritis (66 males and 103 females) a total of 21 ulcers was found, an over-all incidence of 12.5 percent (18.1 percent for males, 8.7 percent for females). The diagnosis in each case was verified by radiology, endoscopy, or operation. Some patients had received a variety of drugs, including acetylsalicylic acid and phenylbutazone. A total of 160 patients received either prednisone, cortisone, or hydrocortisone at some stage. Of the 21 ulcers, 7 were directly attributed to corticosteroids on the basis that the patient was receiving that drug at the time of diagnosis of an ulcer. Thus 7 peptic ulcers occurred in 160 patients, an incidence of 4.4 percent. This study strongly suggests that patients with rheumatoid arthritis have an increased incidence of peptic ulceration, but it does not prove that this incidence is due to corticosteroids.

In summary, there is evidence of retrospective type both for and against an increased incidence of peptic ulceration in rheumatoid-arthritis patients receiving corticosteroids. With the exception of the study by Kern *et al.* the data are insufficient for interpretation. The results of the study by Kern *et al.* are highly suggestive of an increased incidence of peptic ulceration in rheumatoid arthritis patients receiving drugs. It does not prove that this increase is due to corticosteroids.

Prospective Studies

There have been five prospective studies. Sherwood *et al.* followed for 17–28 months 24 patients with allergic diseases treated with triamcinalone (2–16 mg. daily). Radiologic examinations were performed every 3–4 months. There was no evidence of peptic ulcer in any patient. In this small series of patients low doses of corticosteroids did not cause peptic ulceration.

Meltzer *et al.* studied 2 groups of patients. Group 1 consisted of 55 patients (35 with rheumatoid arthritis) taking long-term prednisone (average dose, 14 mg. daily) and Group 2 contained 60 patients (36 with rheumatoid arthritis) in whom corticosteroids were to be administered. All the patients of Group 2 were assessed clinically and radiologically before starting corticosteroids. Of the Group-1 patients, 6 were found to have peptic ulcer (10.9 percent) and 2 ulcers became active during the prednisone therapy, an incidence of 3.2 percent for the

TABLE 2. INCIDENCE OF PEPTIC ULCERATION IN RHEUMATOID-ARTHRITIS PATIENTS RECEIVING CORTICOSTEROIDS

No. patients	*No. ulcers*	*Incidence (%)*	*Author*
30	0	0	Brit. Med. Res. Council, 1954
49	0	0	Savage *et al.*, 1957
60	0	0	Clark *et al.*, 1953
95	0	0	Rothermich & Philips, 1956
132	1	0.7	Cohen *et al.*, 1957
47	2	4.2	Neustadt, 1956
47	2	4.2	Fearnley *et al.*, 1956
156	7	4.2	Stolzer *et al.*, 1957
141	7	4.9	Boland *et al.*, 1956
1,440	76	5.3	Henderson *et al.*, 1955 (lit. survey)
148	6	5.4	Nyfos, 1958
151	9	6.0	Boland, 1957
64	4	6.2	Bunim *et al.*, 1955
213	14	6.5	Savage *et al.*, 1962
546	36	6.6	Amer. Rheum. Assoc., 1955
477	36	7.5	Bollet & Bunim, 1955 (lit. survey)
112	13	11.5	Savage, 1959
39	5	12.8	Black *et al.*, 1957
18	3	16.6	Bollet & Bunim, 1955
68	13	19	Howell & Ragan, 1956
183	35	19	Berntsen & Freyberg, 1961
49	12	24	Hilbish & Black, 1958
13	5	38.4	Evans, 1958

occurrence of new ulcer. In the Group-2 patients, 6 were shown to have a peptic ulcer (10.0 percent) but there was no evidence for the development of a new ulcer or activity of an old ulcer upon radiologic re-examination approximately 5 months later. This study, as well as that of Sherwood *et al.*, suggests that corticosteroids in low doses do not cause peptic ulcer.

Kammerer *et al.* and Gedda and Moritz performed radiologic examinations on rheumatoid arthritis patients treated with corticosteroids (and other drugs). These workers reported an incidence for peptic ulcer of 31 percent and 19 percent, respectively. Most of the patients had symptoms atypical of peptic ulceration. Both groups concluded that corticosteroids were the cause of the large increase in incidence of peptic ulceration. The major criticism of both these studies is that no pretreatment X-ray study was performed. Without baseline studies, it is impossible to implicate corticosteroids as the causative factor. Furthermore, many of the patients were receiving salicylates or phenylbutazone. Finally, the atypical clinical picture raises the question of the nature of the radiologic findings since the X-ray evidence was not confirmed by other methods —e.g., endoscopy. Despite these criticisms both studies are suggestive of an increased incidence of peptic ulceration in rheumatoid arthritis treated with various agents and confirm the findings of Kern *et al.* However corticosteroids are only one factor in this situation and not necessarily the most important.

The difficulties in assessing studies of this type can be seen in the report of Dubois *et al.* These workers reviewed 63 collagen-disease patients receiving corticosteroids. Of the 63 patients, 41 had an X-ray film taken before commencing therapy and 2 were found to have a peptic ulcer (5 percent). It was found that 17 (27 percent) developed an ulcer while taking corticosteroids. However, of the 17 who had an ulcer, only 8 had a pretreatment X-ray study, in all of whom results were normal. Thus it is

certain that only 8 (12.7 percent) developed an ulcer while taking corticosteroids. This figure is high and may be directly attributed to corticosteroids. However, as we have no reliable data as to the incidence of peptic ulceration in patients with collagen disease of equal severity but who were not treated with corticosteroids, we cannot be certain that corticosteroids are the causative factor.

In summary, of the 5 prospective studies available, only the reports of Sherwood *et al.* and Meltzer *et al.* provide any worthwhile evidence. These two investigations show that corticosteroids in low doses do not cause peptic ulceration.

What type of study is required to determine whether corticosteroids cause peptic ulceration? Two groups of patients would be necessary, one receiving corticosteroids the other not. The 2 groups would have to be as evenly matched as possible and have the same disease. All patients would require control radiologic studies and clinical assessment before the trial began. At set intervals (of about 4 months) a repeat X-ray study would be performed and reported upon by a radiologist unaware of the clinical state of the patient or whether he was receiving corticosteroids. Any ulcer discovered would have to be confirmed either by endoscopic or repeat X-ray studies. The trial would continue at least 12 months and the dose of corticosteroids should be dictated by therapeutic considerations. After the study, an attempt could be made to correlate ulcer incidence with the dose. Ideally, random assignment of patients to treatment and dummy treatment should be made. Whether this would be possible would depend on the nature of the disease. Although this type of study would be subject to some variables such as the severity of the patient's illness (so that a patient receiving dummy treatment might come to require corticosteroids) it would avoid some of the obvious faults of previous studies.

Summary

1. The incidence of peptic ulceration patients with chronic diseases is unknown.

2. There is limited evidence that corticosteroids in low doses do not cause peptic ulceration.

3. The incidence of peptic ulcer in rheumatoid arthritis is probably increased. It is not certain that this increase is due to the administration of corticosteroids.

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(The references may be seen in the original article.)

A RATIONAL APPROACH TO FLUID AND ELECTROLYTE THERAPY

Jeremiah G. Turcotte MD, J Arkansas Med Soc 63(10):361–363, March 1967.*

Fluid therapy is a semiquantitative exercise in balancing the input and output of electrolytes and water. Exact determinations of electrolyte losses is neither practical or necessary, since the kidneys and lungs are capable of metabolizing quite varying amounts of minerals and water. By subdividing replacement therapy into basal requirements, abnormal losses, and losses by sequestration, physicians can accurately prescribe intravenous therapy without resorting to a battery of biochemical tests or complicated mathematical formulas. This report presents the physiologic data necessary for an organized approach to fluid and electrolyte replacement.

The estimation of electrolyte requirements is markedly simplified by using a completely interchangeable unit of measure such as the milliequivalent (mEq). A milliequivalent is a weight in milligrams of an ion equal to its atomic weight if the valance is one, and half its atomic weight if the valance is two. For practical purposes it is not necessary to remember this definition, but only to appreciate that a milliequivalent represents the same quantity of ion whether it be contained in serum, food, or intravenous fluid, and no matter in what salt form it is supplied. Dieticians often refer to the number of milligrams of an ion in a particular diet. This may be converted to milliequivalents by dividing the milligrams by the atomic weight of the ion; a 1000 mg sodium diet contains 43.5 milliequivalents of sodium (1000 divided by 23). A convenient method of converting grams of sodium chloride to milliequivalents of sodium or chloride, is to remember that nine grams of sodium chloride, the content of a liter of

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normal saline, contains 154 milliequivalents of sodium and 154 milliequivalents of chloride (154/9 x grams of NaCl = milliequivalents of Na or Cl).

There is no single normal value for electrolytes and fluid required for a healthy adult. As long as sufficient quantity of ions and water within a broad physiologic range is supplied, the kidney, lungs and absorptive surface of the bowel will make the proper adjustments. For this reason only the rather easily remembered figures described as "Usual Requirements" in Table I need be committed to memory.[1] A milliequivalent per kilogram of body weight of sodium, potassium and chloride is physiologically sufficient, but a diet containing only 70 mEq of sodium will taste salt poor to most patients. Large exchangeable reserves of calcium and magnesium are stored in bone and these ions need not be replaced unless parenteral therapy is prolonged beyond 3 or 4 weeks. (Table II). Bone sodium is not readily exchangeable, however, and this ion must be replaced daily. Unless there has been prior malnutrition the lack of adequate caloric intake is tolerated well for at least two weeks by most patients. The baseline requirements of sodium, potassium, chloride, and water constitute a starting point in our planning for proper intravenous replacement. These values are appropriate for relatively healthy adults and do not apply to young children or patients with significant heart, kidney, or liver disease.

The usual parenteral solutions utilized to manage most fluid and electrolyte problems encountered at the University of Michigan Medical Center are listed in Table III. More complex solutions containing many trace ions have no theoretical or practical ad-

TABLE I: DAILY REQUIREMENTS OF 70 KG. MAN

	Range	*Usual*
Volume of Fluid	2000–3000 cc	2500 cc
Sodium	50–125 mEq	70 mEq
Potassium	50–100 mEq	70 mEq
Chloride	50–100 mEq	70 mEq
Calories	1500–3000	2000

TABLE II: COMPOSITION 70 KG. MAN

Component	Plasma	Interstitial fluid	Intracellular	Bone	Total mEq
Water	5%	15%	50%	5%	50kg
Na+	10%	30%	15%	45%	4,500
K+	<1%	1%	94%	4%	3,500
Cl–	15%	45%	15%	25%	2,200
Ca++	<1%	<1%	<1%	99%	60,000
Mg++	<1%	<1%	50%	48%	2,100

TABLE III: ELECTROLYTE CONCENTRATIONS OF COMMON PARENTERAL SOLUTIONS IN MILLIEQUIVALENTS PER HOUR

	Na	K	Cl	HCO_3	LACTATE	Ca	NH_4
NORMAL (0.9%) SALINE	154	0	154	0	0	0	
LACTATED RINGERS (HARTMAN'S)	130	4	110	0	27	2.7	
POTASSIUM CHLORIDE		20.40	20.40				
3% SALINE	517		517				
1.5% SODIUM BICARBONATE	178			178			
0.9% AMMONIUM CHLORIDE			167				167

vantage and are generally more expensive. Physicians should select a few preferred parenteral solutions, be familiar with their contents, and manage clinical problems by manipulating the proper proportions of these solutions. Hartman's or lactated Ringer's solution has an electrolyte distribution similar to normal serum and interstitial fluid electrolyte concentrations. We use this solution to replace extracellular fluid deficits. This choice of solution could be criticized because the sodium content is slightly lower, the chloride concentration slightly higher, and the quantities of potassium and calcium are too small to be useful. We continue to use Hartman's solution as our basic salt replacing solution because it is inexpensive and can be obtained in most hospitals. Normal saline is not a physiologic solution because of the great excess of chloride which biologically acts as an acid. Potassium is usually supplied in vials containing 20–40 mEq of potassium and chloride. A day's basal requirement can be provided by ordering 2000 ml Dextrose in water, and 500 cc of Hartman's solution. Twenty milliequivalents of potassium and chloride can be added to each of the 3 bottles. This provides 2500 ml of water, 65 mEq of sodium, 62 mEq of potassium, and 115 mEq of chloride. These values are well within physiologic ranges.

A common indication for intravenous therapy is for the support of patients in the postoperative period. Normal body metabolism is altered by the trauma of a surgical procedure and its associated anesthetic.[2,3] This stress stimulates the release of aldosterone and antidiuretic hormones with consequent retention of sodium, chloride, and water. On the day of operation and first two postoperative days only about one-half the usual basal requirements of sodium and chloride and 2000 ml of fluid are needed. Supplementary potassium may be withheld until the third postoperative day because the usual body reserve plus endogenous release of intracellular potassium from catabolism and trauma provide a sufficient quantity of this ion.

A second most important factor which modifies fluid and electrolyte requirements in the postoperative period is the obligatory sequestration of extracellular fluid into traumatized tissue. If losses are below 500 ml, such as occurs in operations of the magnitude of an inguinal herniorrhaphy, there is little physiologic consequence. In more extensive procedures or when peritonitis or bowel obstruction complicates patient care several liters may be lost from the circulation and this must be replaced if hypotension and renal failure are to be avoided. Since there is no way to measure these losses and since the physical signs of hypovolemia do not become apparent until 5 percent of body weight (3500 ml in a 70 kg man) is lost, these deficiencies are replaced on the basis of a clinical estimate of the losses incurred. A patient undergoing a procedure of the magnitude of a vagotomy and pyloroplasty might receive 1500 ml of Dextrose in water and 250 ml of Hartman's solution as his basal requirement on the day of operation. To this we would add 750 ml of Hartman's as our estimated loss from the circulation due to sequestration of extracellular fluid into the wound and peritoneum. This provides 2500 ml of water, 65 mEq of sodium and 55 mEq of chloride. No extra potassium is needed.

Proper replacement of abnormal losses of gastrointestinal fluid has been confused because different textbooks list widely varying values for the concentrations of electrolytes in intestinal, biliary or pancreatic secretions. These discrepancies occur because of the variation between individuals and the different conditions under which the measurements were made. Table IV lists average values. Only the

TABLE IV: COMPOSITION OF GASTROINTESTINAL FLUIDS AND REPLACEMENT SOLUTIONS

	Na	*K*	*Cl*	*HCO_3*	*REPLACEMENT*
ACID STOMACH	60	10	100	0	NORMAL SALINE AND K (half strength)
LOW ACID STOMACH	130	10	75	10	LACTATED RINGERS AND K
DUODENUM	135	10	75	50	LACTATED RINGERS AND K
ILEUM AND DIARRHEA	135	10	100	25	LACTATED RINGERS AND K

relationship of these secretions to normal serum electrolytes need be remembered and not the exact values themselves. The value listed for duodenum includes bile and pancreatic secretion. Note that the sodium concentration is approximately the same as in serum for secretions originating below the pyloric sphincter. In an acid stomach sodium concentration is about one-half normal serum sodium. Potassium content is almost always two to four times serum concentration in these gastrointestinal losses. In most cases intestinal, biliary, or pancreatic loss may be replaced on an equal volume basis with a neutral or slightly alkaline balanced salt solution such as lactated Ringer's. In substituting for losses from an acid stomach half the volume can be replaced with normal saline and half with Dextrose and water. Hypokalemia will be avoided by replacing 20 mEq of potassium for every liter of fluid lost from any of these sites. By adding this replacement schedule to the usual normal daily requirements, a logical plan of parenteral therapy can be followed. Our average values for gastrointestinal fluid electrolytes may differ significantly from the actual values in a specific case. If abnormal losses exceed 1000 ml daily over a three or four day period the actual electrolyte content of the fluid being lost should be measured, and serum electrolytes checked frequently so that therapy may be properly adjusted.

To this point we have been concerned with losses in patients whose serum electrolytes are relatively normal. When there is a disproportionate loss of one ion the serum electrolyte pattern can be markedly distorted and symptoms result.[4] Hyponatremia and hypokalemia are common disturbances encountered. An estimate of a sodium deficit may be made by calculating the deficiency of sodium in the extracellular space on the basis of serum sodium and body weight of the patient. (Table II). If serum sodium has fallen to 125 mEq per liter, then 15 mEq of sodium is needed for each liter of extracellular fluid to raise the serum sodium to 140 mEq. Since extracellular fluid represents 20 percent of body weight a total of 210 mEq of sodium would be required in a 70 kg patient (20 percent x 70 kg = 14 liters ECF; 14 x 15 = 210 mEq). This method of calculation yields a conservative estimate of a sodium deficit and replacement therapy must be monitored and adjusted by frequent determinations of serum electrolytes, vital signs, urine output and repeated physical examinations. Potassium deficits are corrected by administering two to four times the usual daily requirements of this ion until serum potassium and other parameters of hypokalemia become normal. Since ninety-five percent of body potassium is intracellular, serum potassium alone is not an accurate reflection of total body potassium and there is no practical way to even roughly estimate the magnitude of a deficit of this ion; therefore an empirical method of replacing potassium is required.

Summary

Fluid and electrolyte replacement is simplified by dividing a patient's requirements into 3 categories:

1. The usual basal requirements.
2. Modifications of these requirements as indicated by the specific condition and treatment.
3. Replacement of abnormal losses or sequestrated fluid.

In most cases easily remembered average values may be used to quantitate these categories of replacement therapy, because the kidney and lungs are capable of making minor adjustments. By organizing an understanding of basic fluid therapy exceptional and more complicated cases can be readily recognized and the proper modification in therapy can be instituted.

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MEDICAL ABSTRACTS

THE FLUOXAIR—ANESTHESIA FOR PEACE OR WAR

LCDR Thomas H. Joyce III MC USN, Naval Hospital, Portsmouth, Va., and LCDR Charles J. Vacanti MC USN, Naval Hospital, NNMC, Bethesda, Md. Med Serv J Canada 22: 719–723, 1966.

The following abstract of this article by LCDR Charles J. Vacanti, is published with the permission of the Associate Editors of Medical Services Journal, Canada, together with some unpublished studies by LCDR Vacanti done at the Naval Hospital, NNMC, Bethesda, Maryland.

The Fluoxair has been described as an anesthetic system designed to meet the requirements for simple, efficient equipment to administer safe anesthesia in remote areas of the world and for major civil disaster situations. The Fluoxair is a completely portable anesthetic machine designed for the administration of halothane vapor in air to which supplemental oxygen may be added if desired and if available. The unit comes packed in a sturdy case measuring twelve by ten by fourteen inches, and weighs about twenty-two pounds. All the equipment necessary for the administration of an anesthetic can be contained within the case.

The Fluoxair unit itself consists of a thermally compensated wick vaporizer of the Fluotec^{R}-type with a capacity of 70 cc. of liquid, mounted on a base incorporating an air inlet port, a spring loaded, concertina bellows, non-rebreathing uni-directional valve system, and an "oxygen economizer".

The vaporizer has several built-in safety features. It cannot be overfilled. When charged with liquid anesthetic agent, it will not spill if overturned. It is designed to deliver concentrations of halothane from 0.5% to 5.0%, the calibrations being quite accurate between 68° and 119° F. when the patient's minute volume is between three and eight liters per minute.

The spring loaded concertina bellows on the anesthetic unit make it suitable for use as a resuscitation apparatus. The capacity of the bellows is three liters. The uni-directional valve system is suitable for use with spontaneous, assisted or controlled respiration; and its resistance is comparable to other widely used non-rebreathing equipment.

For the Fluoxair to be operated with supplemental oxygen, a three liter range, bobbin-type, oxygen flow meter is provided, with the appropriate regulator, cylinder pressure gauge, and pin indexed yoke attachments for standard oxygen cylinders. A 500 cc. rigid reservoir located between the vaporizer and the air inlet port, is termed an "oxygen economizer". When supplementing air with oxygen, the oxygen passes into the economizer during exhalation displacing air retrograde through the air inlet port. As the patient inhales, he draws first oxygen from the economizer and then air via the inlet port. The percentage of oxygen received by the patient is a factor of his minute volume and the rate of flow of oxygen. A graph depicting this relationship is conveniently mounted on the base of the apparatus for ready reference. The average adult with a six liter minute volume can be supplied with about 33% oxygen at a flow rate on only one liter per minute. Thus, the economizer allows for relatively high inspired oxygen concentrations with relatively low oxygen flow rates. In this manner, a small D oxygen cylinder can be used up to twenty hours.

With these advantages in mind, three studies were conducted to test the efficacy of using the Fluoxair units with surgical teams, FMF augmentation units, and evacuation teams.

In the first series, twenty-six adult males varying in age from 17 to 80 years of age were investigated. The patients were unpremedicated except for atropine. Anesthesia was induced by mask, and room air was utilized as the carrier gas for the halothane anesthetic and was the sole source of oxygen. In 21 of the 26 patients, spontaneous respiration prevailed throughout the anesthetic. In the remaining five patients, respiration was assisted or controlled because either a muscle relaxant had been given to facilitate the operative procedure, or the tidal volume fell below 250 cc. per minute as measured by a Wright respirometer which was placed on the inspiratory limb of the Fluoxair. In all patients, arterial blood

samples were analyzed for PaO_2, $PaCO_2$, and pH by the Astrup method. Anesthetic time varied from 45 to 230 minutes, the average being 90 minutes.

To facilitate a rapid induction, the indicated inspired concentration of halothane was not reduced to 4–5% as rapidly as tolerated by the patient. The average induction time was two minutes, with a range of one to four and one-half minutes. At the point of induction where the eye becomes centrally fixed with a constricted pupil, if the indicated inspired concentration of halothane was not reduced to 1–2%, profound respiratory depression rapidly ensued with resultant arterial oxygen tensions ranging as low as 40 mm. Mg. However, if the inspired anesthetic concentration was reduced at this reference point, arterial oxygen tensions averaged 83 mm. Hg. with a range of 78 mm. to 96 mm. Hg. Blood gas data during the operative period revealed that the arterial oxygen tension generally remained at or slightly above preoperative levels, while a slightly increased arterial carbon dioxide tension was accompanied by a minimal decrease in arterial pH. Resting arterial blood gas studies drawn in the recovery room 15 to 20 minutes after anesthesia closely correlated with their preoperative counterparts.

In the second series, patients again were anesthetized under the same protocol but with supplemental oxygen being administered. It was found that with oxygen flows as low as 500 cc. per minute, the arterial oxygen tension rose rather than fell, even during induction.

In the third series, the potential of the Fluoxair to vaporize, in addition to halothane, methoxyflurane, diethyl ether, and the halothane-ether azeotrope was investigated. The unit was used to administer anesthesia to one hundred unselected patients, male and female, ranging in age from 15 days to 84 years, including all types of emergency and elective surgical procedures. In addition, it was used to resuscitate nineteen patients. Procedural time varied from 100 to 600 minutes duration, the average being 87 minutes. In the pediatric patients, aside from using pediatric sized masks or endotracheal tubes, no change in equipment was made from that used in adults.

Using halothane or the halothane-ether azeotrope, the Fluoxair readily delivered concentrations necessary for induction and maintenance of anesthesia. The unit also delivered adequate maintenance concentrations of methoxyflurane and diethyl ether. Inductions with the latter two agents were prolonged; this may have been a result of the low maximum concentration of these agents that the vaporizer could deliver. This did not prove to be an obstacle to using these two agents in the apparatus for maintenance of anesthesia. Inductions were readily facilitated by the addition of an intravenous thiobarbiturate, and/or an intravenous muscle relaxant. In the absence of these, the open drop technique provided a satisfactory induction for methoxyflurane and diethyl ether.

The Fluoxair can be used as a quantitative multiagent vaporizer. By comparing the vapor pressure of the agent being used to the vapor pressure of halothane, the conversion factor for the vaporizer dial settings can be calculated, and the percentage of the volatile agent being delivered can be ascertained.

The Fluoxair is a new draw-over apparatus designed for the administration of volatile anesthetics utilizing room air. It is functionally independent of a supply of compressed gases or carbon dioxide absorbent. It is so designed that it may be used with supplemental oxygen if available and if desired. The apparatus is compact and portable, and clinically can be used with all the volatile anesthetic agents. It may be used for resuscitation. The same apparatus can be used for both adults and children. The Fluoxair is eminently suited for adverse military situations, for civil defense and disaster purposes, and even for routine hospital use.

CLINICAL IMPLICATIONS OF FATTY LIVER

Eddy D. Palmer MD, (From the Veterans Administration Hospital, East Orange, New Jersey.) GP 35: 125–129, April 1967.

The disease discussed in this report is defined by the author as "simple nutritional fatty liver (fatty liver in alcoholic persons)". The important histopathologic feature is that, under light microscopy, the fat is the only or almost only abnormality in the specimen. Excluded are instances of portal cirrhosis in which there is prominent fatty metamorphosis and, in fact, all cases in which other abnormal features are prominent such as nodular regeneration, hepatocellular necrosis, fibrosis, inflammatory infiltrate, pigment, or ductal hyperplasia. One hundred thirty-one patients with this biopsy diagnosis were studied for variable periods in the hospital and then as outpatients for periods up to seven years. Ninety-eight admitted heavy alcohol intake

over long periods; nine had histories suggesting viral hepatitis in the past; seven were excessively obese; five had diabetes; and nine others had chronic relapsing pancreatitis. No history suggestive of contact with known or suspected hepatotoxins other than alcohol could be obtained. Only 11 sought medical help because of the consequences of the fatty liver. Most were detected through chance discovery of a large liver. Fifty-four had esophageal varices and 11 had mild bleeding. Treatment did not appear to influence the severity of histopathologic changes or the size or extent of varices. Fatty liver had further clinical importance because it influenced treatment of other medical problems.

ABNORMAL URINARY STEROID EXCRETION AND SUBSEQUENT BREAST CANCER—A PROSPECTIVE STUDY IN THE ISLAND OF GUERNSEY

R. D. Bulbrook M Sc PhD and J. L. Hayward MB FRCS, (From the Division of Chemistry and Biochemistry, Imperial Cancer Research Fund, Lincoln's Inn Fields, London, and the Department of Surgery, Guy's Hospital, London.) Lancet 1: 519–522, Mar 11, 1967.

The authors report a prospective study of a normal population undertaken to investigate a possible association between abnormal hormone excretion and the subsequent development of breast cancer. Twenty-four hour specimens of urine for determinations of the excretion of androgen (etiocholanolone) and corticosteroid metabolites (17 hydroxycorticosteroids) were collected from women on Guernsey between the ages of 35 and 55 over a period of five years. A total of 4,850 such specimens were collected. Nineteen of these women have since developed breast cancer. In a substantial proportion of the cancer patients, the excretion of androgen and corticosteroid metabolites was abnormal. The abnormality was multidirectional and, when compared with controls, tended to deviate further from the control mean values than did the individual controls. The deviation was significant statistically. They point out that the term "subsequent development of breast cancer" may be inaccurate because it is possible that the tumor was already present when the urine was collected in many of the women but had not become apparent clinically. The average time between the urine collection and diagnosis of breast cancer was 31 months (3-61 months). They feel that the results lend some support to the thesis that abnormalities in corticosteroid and androgen metabolite excretion are associated with the etiology of human breast cancer. The possibility of using the steroid determinations for screening a normal population in order to identify a group of women with a high risk of subsequent breast cancer is discussed.

DENTAL SECTION

THE IMPACT OF MILITARY DENTAL CARE ON DENTAL HEALTH

G. H. Rovelstad, Milit Med 131: 168–177, February 1966.

The dental health of naval recruits from the eastern one-third of the United States are reviewed according to a survey of 2,027 recruits selected at random over a six month period from 15,543 recruits entering a naval training center at Bainbridge, Maryland. The average DMF with the study group was 13.6 (excluding 3rd molars) with the New England States having the highest DMF (16.7) and Southern Atlantic States and Southeast Central States having the lowest (12.7 and 12.6 respectively). The state of dental health as indicated by the amount of untreated dental disease (carious teeth, teeth to be extracted and missing teeth) is reported in relation to the various demographic factors describing socio-economic status of the individual recruit. Although the rate of dental caries is similar in all groups the state of dental health is best in the higher socio-economic groups. Additionally, the recruit who has obtained regular dental attention is in the best state of dental health. Clearly, dentists play an important role in determining the state of dental health regardless of the rate of dental disease involved. The survey group was therefore classified according to the need for dental care as determined by the treatment needs, (extractions, restorations, etc.). Fifty of the highest and fifty of the lowest need subjects were grouped respectively and studied further. The group needing the least treatment at time of reporting again were of the higher socio-

economic background. Questionnaires included as a part of the survey and designed to seek opinions about dentistry and dental health were then evaluated for these groups. The opinions of the individuals in the low need group were most frequently rated "appreciative", "respectful" and "cooperative" as compared to "indifferent","critical" and "disrespectful" in the high need group. The individuals having the least experience with dentists and dental care were most critical. However, upon being exposed to dentists and dental care in the military services it is logical that these individuals would have opportunity to improve their opinions and continue to seek dental care in the future.

(Abstracted by: Naval Dental Research Institute, Great Lakes, Illinois.)

MANUAL DEXTERITY AND THE USAF DENTAL LABORATORY TRAINEE

S. Jolkovsky and D. E. Barnhill, Milit Med 131: 155–160, February 1966.

A chalk carving test was developed to measure manual dexterity of prospective candidates for dental laboratory specialist course at the USAF Medical Service School. The test consisted of simply carving a piece of chalk to specified measurements within a given period of time, following a set of given instructions. On preliminary testing with sixty-four students enrolled in the course, the average chalk carving scores as given by four raters were clearly related to performance as reflected by laboratory performance tests grades within the course ($r=.68$) with a higher correlation than the Airmans Qualification Examination test scores had to the laboratory performance ($r=.55$). Of these sixty-four students, twelve failed to complete the course because of lack of manual dexterity. Subsequently, the chalk carving test was given to 149 candidates for the course. Based on all factors including the chalk carving test for selection fifty-six airmen were enrolled. None of these failed to complete the course because of lack of manual dexterity. Since 1962 this test has been applied for the selection of 270 students. Nine have failed to complete the course because of lack of manual dexterity, however, only two of these nine achieved a qualifying score on the dexterity test. It has been shown that the average elimination rate of 15% prior to the use of the test has been reduced to 5% by the use of the chalk-carving test to measure manual dexterity as a qualification for entrance.

(Abstracted by: Naval Dental Research Institute, Great Lakes, Illinois.)

GINGIVAL TISSUE HEALTH WITH HAND AND POWER BRUSHING: A RETROSPECTIVE WITH CORROBORATIVE STUDIES

Manhold, J Periodont 38(1), Jan–Feb 1967.

Studies were performed comparing the power brush with the hand brush as to the efficacy of each in removal of oral debris and in the inhibition or reduction of calculus formation. Corroborative studies, over a six year period, were cited as to the relationship of the power brush to keratin formation, gingival pathology and tissue metabolism.

It was concluded that (1) personal toothbrushing habits play a vital role in gingival health; (2) the power brush when properly used does not elicit any gingival pathology; (3) the power brush does not alter the tissue's basic metabolism; (4) the power brush does remove more oral debris following a meal than does the hand brush; and (5) does appear to reduce the amount of calculus formation on the lingual surfaces of the mandibular anterior teeth over a three month period.

Of the 48 persons taking part in this last study, 39, or 81%, had sustained a lower calculus rating after using the power brush for a 3 month period, than they had when using the manual brush for the same period of time. One of the 48 subjects remained the same and 8 subjects had an increase in calculus formation after using the electric brush.

(Abstracted by: CAPT P. F. Fedi DC USN.)

RESERVE SECTION

AMERICAN BOARD CERTIFICATIONS

American Board of Internal Medicine

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LT Alfred D. Beasley MC USNR
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LCDR Robert J. Weiler MC USNR

American Board of Thoracic Surgery

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LCDR John L. Kuehn MC USNR

AEROSPACE MEDICINE SECTION

NAVAL AVIATION MEDICINE LUNCHEON AT AEROSPACE MEDICAL ASSOCIATION CONVENTION

The luncheon was a resounding success. One hundred seventy Flight Surgeons, Aviation Physiologists, Aviation Experimental Psychologists and guests attended. Among the honored guests were the Surgeon General of the Navy, VADM R. B. Brown MC USN; RADM H. H. Eighmy MC USN, Commanding Officer of Aerospace Medical Center; RADM L. C. Newman MC USN (Ret); and RADM J. L. Holland MC USN (Ret).

As principal luncheon speaker, CAPT W. M. Snowden MC USN, Assistant Chief for Aerospace Medicine, provided the audience with a general overview of Naval Aerospace Medicine Programs and Progress. A summary of his remarks follows.

During fiscal year 1966, one hundred thirty-one Naval Flight Surgeons were trained at the Naval Aerospace Medical Institute, Pensacola. In addition, 7 Army, 2 Public Health Service and 4 Flight Surgeons from allied countries were trained.

The Navy now has on duty seventeen Naval Aviator/Flight Surgeons, the most recent being designated in February 1967. Two of these are graduates of the U.S. Naval Test Pilot School at Patuxent River; one is assigned to NASA/APOLLO as the first M.D., Scientist/Astronaut; and one is assigned to the Manned Orbital Laboratory project.

Other space medicine contributions are being made through the assignment of naval personnel to the NASA Manned Spacecraft Center at Houston, where one Flight Surgeon, an MSC Aviation Physiologist and five hospital corpsmen assist in support of the centrifuge and low pressure chamber and with other projects. The Bureau of Medicine and Surgery continues to provide aviation and general medical support to NASA for manned flight monitoring and recovery operations. All naval laboratories (NAMI, AMRD, ACEL, NMRI) and many other facilities, such as the Pacific Missile Center, Point Mugu and Naval Aerospace Recovery Facility, El Centro are deeply involved in space medicine oriented projects,

as well as meeting their heavy commitments to operational support.

Some recent changes are of significance. Navy residency training in aerospace medicine continues at 18 per year, but eleven universities are now included in the program of awarding MPH degrees to Flight Surgeons. It is hoped that soon the number of residents can be increased.

The Army and Navy now have a joint aerospace medicine research project. One Navy Flight Surgeon is currently assigned to Fort Rucker, and two Army Flight Surgeons are assigned at Naval Aerospace Medical Institute.

The authority to designate Aviation Physiologists and Experimental Psychologists was granted by the Secretary of the Navy in January 1966, and in April 1967 approval was granted for these personnel to wear the wings insigne.

During 1966 the Physiology Training Unit Building at NAS, Miramar was dedicated, and NAS, Oceana put into commission a low pressure chamber device 9A9.

Four major training films were completed during the year: *Doctor on the Flight Deck, Fit to Fly, Curtain Call* and *Crash Investigation*. Ten film clips on oxygen sense, ejection, physiology and flash blindness were distributed. Six Flash Blindness Trainers were delivered to Navy and Marine attack jet bases together with training syllabi and manuals.

The support of the conflict in Southeast Asia and the world-wide Navy commitment; i.e., twenty-four carriers, each assigned three flight surgeons, along with thirty-one Flight Surgeons deployed in SEASIA with Marine Air Wing Units, continue to represent a major portion of Navy medical operational effort. Six additional Flight Surgeons have recently been assigned to support the newly formed Fifth Marine Division.

The Navy is keeping pace with the rapid advances in aerospace and aviation medicine. Naval Flight Surgeons continue to find their duty, be it operational, clinical, administrative or in research, to be a rewarding experience and one which offers a gratifying career.—AeroMed, BuMed.

CHANGE OF COMMAND AT NAMI

Change of command ceremonies were held May 2 at the Naval Aerospace Medical Institute, Pensacola. CAPT Joseph W. Weaver MC USN relieved CAPT H. C. Hunley MC USN as Commanding Officer. CAPT Hunley goes to Norfolk to be Staff Medical Officer for Commander, Naval Air Forces, Atlantic Fleet. CAPT Weaver went to Pensacola from the Bureau of Medicine and Surgery in Washington where he had been director, Aerospace Medicine Operations Division since 1963. He now returns to head the school where he was a student in 1942 when he completed the course for Navy Flight Surgeons. Since 1942 he has served in Patrol Wing Three, Air Transportation Squadrons Seven and Three, and he has been Medical Officer of aircraft carriers, Mindoro, Valley Forge, Hornet, and Naval Air Stations, Anacostia and Jacksonville.

Dr. Weaver is from Atlanta, Georgia, where he was born Sept 4, 1913. He received his B.S. Degree from Duke University and his M.D. from Tulane. At University Hospital, Augusta, Georgia, from 1937 to 1941, Dr. Weaver was an Intern, Assistant Resident Medicine, Resident in Medicine and Fellow in Medicine.

Professional societies of Dr. Weaver include American Medical Association, Association of Military Surgeons and Aerospace Medical Association. His honors include Who's Who in American Colleges and Universities 1937; Fellows, and Executive Council, Aerospace Medical Association.

CAPT Weaver is married to the former Miss Mary Price Woodroe of Charleston, West Virginia. They have two sons, LT Joseph William Weaver MC USN, an Intern at Naval Hospital, San Diego; and James Woodroe Weaver a Pre-Med Sophomore at Duke University.—*Capsule,* NAMC 3(8), April 28, 1967.

NEW WINGS FOR PHYSIOLOGISTS AND PSYCHOLOGISTS

Aviation Experimental Psychologists and Aviation Physiologists donned their wings of gold for the first time during the recent 38th Annual Meeting of the Aerospace Medical Association.

The change to the U.S. Navy Uniform Regulations to permit the wearing of breast insignia by these newest members of the Navy's aeronautical organization was approved by Under Secretary of the Navy, Robert H. B. Baldwin on 12 April 1967.

The new gold wings are similar to those worn by Flight Surgeons, except the gold oak leaf of the Medical Service Corps replaces the Medical Corps leaf with the acorn.

Aviation Experimental Psychologists and Aviation Physiologists were designated as crew members and ordered to duty involving flying in February 1966. This relatively small group of officers, ap-

proximately 65 in number, is composed of highly specialized individuals who are assigned to such duties as in-flight analysis of human performance in fleet and training operations covering a myriad of weapons systems and tactics, providing extensive training for all aircrew personnel in airborne protective equipment and egress systems, and test and evaluation of new and improved aircraft systems.

Approval to wear wings fully identifies these officers as members of the Naval Aviation Team and is expected to enhance their overall effectiveness.—AeroMed, BuMed.

OXYGEN DEFICIENCY AND CARBON MONOXIDE

Occupational Health Hazards, Release No. 48, BuMed-73 letter of 1 March 1967 (Notal) Abstracted.

An employee entered a closed void surrounding a fuel tank to survey structural damage. After being in the void approximately ten minutes, the employee realized he was about to lose consciousness and he left the void. He had no memory of his exit and was stuporous for a short period during which the ship's force administered oxygen. About 1 hour later, the patient reported to the dispensary complaining of dizziness and headache. Investigation disclosed that the void had been inerted by the ship's gas generating system. The inert gas is composed of combustion products of JP-5 fuel burned in a generating system. Spaces and fuel lines to be inerted are flushed with the inert gas until oxygen content of the air in the void or line is about 10 percent, which is less than that required to support life. The inert gas also contains hazardous amounts of carbon monoxide to the extent of 1,000 ppm, and nitrogen dioxide, about 50 ppm, if the system is operated correctly in accordance with NAVSHIPS Manual 323–0058 for Model 40 inert gas producer.

The industrial hygiene division, in conjunction with the gas-free engineer, determined that the oxygen content of the air in the void was about 16 percent, and the carbon monoxide content was about 400 ppm. The tank had not been gas-freed nor certified for entry in accordance with current directives. Entering tanks that have not been certified gas-free is obviously dangerous. In addition, this procedure for generating and using inert gas can produce a serious hazard. The industrial hygiene division was unaware that this type of inerting was being used. The operating manual is misleading in that Section 3–1 states that the inert gas should contain less than 1 percent oxygen, 0.1 percent carbon monoxide, 0.1 percent hydrogen, and 50 ppm nitrogen dioxide; yet page 1–1 states that the inert gas produced is neither toxic nor particularly hazardous. This statement is erroneous.

It was recommended that all personnel who must enter fuel tanks or voids be made aware that tanks inerted with gases from burned fuel present a potentially serious hazard if not properly gas-freed prior to entry. *The hazards of entry in any void before being certified by the gas-free engineer should be re-emphasized.* It was further recommended that residual concentrations of carbon monoxide and nitrogen dioxide be less than 50 ppm and 5ppm respectively after gas-freeing is completed. The industrial hygiene division should be consulted when the presence of these or other toxic gases are suspected. All inerted voids around fuel tanks should have a permanent metal warning sign attached to the tank cover as follows: "Danger—Do Not Enter —Inert or Toxic Gases". The industrial hygiene division prepared a presentation for stand-up safety meetings, emphasizing the hazards and proper precautions. In addition, the planning officer has taken action on the installation of permanent signs on inerted voids, and the correction of errors in the NAVSHIPS Manual.

(Ed. Note: Good advice for consideration of Engineers and Medical Officers aboard any ship!—AeroMed, BuMed.)

CIVIL PILOT DEATHS ATTRIBUTED TO ALCOHOL

The Federal Aviation Agency has reported the somewhat startling statistic that more than 300 pilots killed in light-plane accidents in the last four years had alcohol in their blood. Post-mortem examinations showed that two-thirds of the private pilots had consumed the equivalent of more than two ounces of liquor or two bottles of beer, FAA reported. Pilot toxicology examinations conducted in about 900 of the 2,084 small-plane accidents between 1963 and 1966 indicated alcohol present in approximately one third of the cases.

However, the Civil Aeronautics Board has somewhat different figures. A computer survey by the Board of 1,024 fatal "general aviation" accidents in 1964 and 1965 implicates alcohol as a probable causative factor in only about 8 percent of the crashes. Dr. Stanley R. Mohler, chief of the aeromedical applications division in FAA's Officer of Aviation Medicine, explained the statistical disparity.

He said that FAA data includes all accidents in which alcohol may be even the slightest factor whereas CAB narrows its analyses to specific probable causes because it has a legal responsibility for accident investigation.

The Board would decide that alcohol was a probable cause if it found 100 milligrams of alcohol per 100 milliliters of blood, or the equivalent of about *seven* martinis, he explained. He cited an FAA analysis of 1963 light plane crashes in which 56 out of 158 pilots killed had ethyl alcohol concentrations in blood or tissue of 0.015 percent or higher, with the average blood alcohol for the group being 0.145.

"When four ounces of pure alcohol are consumed by an average man four hours prior to an accident, a blood alcohol level of 0.04 percent or more will be found at the time of the accident," Dr. Mohler said. "Consequently, it appears that a significant number of general aviation pilots are undertaking to pilot aircraft shortly after indulging in alcohol, and that an aggressive airman education program regarding the incompatibility of alcohol and flying is indicated."—Extracted from Environmental Health Letter 6(7), April 1, 1967.—From FAA report, "Recent Findings on the Impairment of Airmanship by Alcohol", by S. R. Mohler MD, FAA Officer of Aviation Medicine Report 66–29, September 1966.

FAA OFFERS SAFETY FILMS

Films suitable for use by AMEs at pilot and civic meetings are available on a loan basis, and may be of interest to Navy audiences. Some titles are:

A Traveler Meets Air Traffic Control
One Eye on the Instruments
The Other Passenger
Chemical Safety in Aerial Application Flight
Density Altitude
Wake Turbulence
Rx for Flight

Films may be requested from:

FAA Film Library, AC–43.1
FAA Aeronautical Center
P.O. Box 25082
Oklahoma City, Oklahoma 73125

—AeroMed, BuMed.

HOW LONG AND HOW OFTEN CAN A PILOT FLY?

As Flight Surgeons we are often consulted on the question of flight frequency and duration for pilots and crews. The engineers, planners, tacticians and pilots often expect precise quantitative answers for this complex psychobiological problem. The following thoughts were recently offered on this subject:

The physical and psychological limitations on mission length, imposed because of pilot and/or radar operator, are the most flexible, personnel and nonquantitative ones in the entire weapons system. Pilots don't run out of fuel each mission at the same time, as will the aircraft (assuming equal power settings, altitudes, etc.). The advantage of having a human manager versus a mechanical one in the control loop is the inherent capability of man to utilize *judgment* and to *extend* himself physically and psychologically when required by the mission.

Any medically determined figure of mission limitation must assume average conditions, usual rest, normal morale/motivation and satisfactory physical status. Decrements in any of these areas can markedly reduce safety and operational effectiveness of the pilot. Conversely, when operational conditions demanded, the time can be doubled, even quadrupled, almost to the point of complete physical collapse; but some individuals will collapse earlier than others.

Biomedical monitoring indices of pilot stress and fatigue are being developed by the Aeromedical Team and others. The Safety Center (Aeromedical Department) is exploring the entire spectrum of missions, human factors and safety under the Human Error Research and Analysis Program (HERAP). At present the suggested biomedical limitations on mission length are based on extrapolation of other medical research and upon Flight Surgeon operational experience and judgment. It is hoped that ad hoc research in the areas of combat stress will enable the development of valid Operational Indices. These will remain only aids to the Flight Surgeon and his Commanders, by whom professional judgment and operational requirement must still be applied. But timely rest for an aviator nearing physical or psychological exhaustion can save him and his plane to fly another day.—CAPT F. H. Austin MC USN—AeroMed, BuMed.

CAPT CHRISTIANSEN ADDRESSES GRADUATING CLASS OF NAVAL FLIGHT SURGEONS

Capsule, NAMC 3(8), April 28, 1967.

CAPT John S. Christiansen, USN, who traded his law practice in Florida for a colorful career in Naval Aviation, was the guest speaker at the recent gradu-

ation of Student Flight Surgeon Class 114, Naval Aerospace Institute, Pensacola. Commander of Attack Carrier Wing Four NAS, Cecil Field, CAPT Christiansen spoke of the challenge that awaits fledging flight surgeons who are set to practice aviation medicine with the Fleet. Reminding them of their relative inexperience in Naval Aviation and Naval customs and traditions, he encouraged the surgeons to bridge this gap by assiduous study and application. Doing so, he said, contributes to the betterment of surgeon-pilot relationship. As the aviators' prodigious capacity for knowledge, perfection and skill is reflected on most any facet of their activity and endeavor, the speaker said, they equate high caliber naval officers to top flight surgeons.

Flying in a high performance operational airplane off an attack carrier is a tough, hard and dangerous profession, the Wing Commander declared. The tremendous demands made upon the pilots tend to mold them into arrogant, egocentric and short-range thinking individuals and they are frequently hard to deal with and at times unreasonable. CAPT Christiansen indicated that aviators have a lurking aversion toward flight surgeons; they consider them as a threat to their own careers since the path to advancement, prestige and financial security is directly related to their ability to remain in a flying status. Flight surgeons, he said, by the very nature of their professions, have the power of analysis and experience to recommend the grounding of pilots; hence, pilots are reluctant to accept surgeons into their confidence unless they prove to be level-headed, practical and reasonable doctors. Their effectiveness, therefore, is directly proportional to the degree of confidence and trust aviators have in them. The graduates were reminded that the best way to deal with aviators is to fly with them; and that they will respect flight surgeons for it, because only by flying can the doctor know well the aviators, their business and particular problems.

The importance of flight surgeon—squadron commander relationship and keeping the commanding officer informed of pilots' physical conditions was stressed in the talk. Citing first hand experience, CAPT Christiansen recounted a near tragedy aboard carrier. Due to a flight surgeon's failure to notify the commanding officer of a pilot's deteriorating vision a 3½ million dollar plane and 3 lives were recklessly brought within a hairbreadth of disaster. Luckily, the pilot was successfully talked down to the carrier deck after 30 minutes of nightmarish operation in darkness.

"No self respecting naval aviator wants to be grounded, even temporarily, so be careful how you hand out those grounding chits," the captain advised. Before taking safety violators to the commanding officer, flight surgeons should give them a chance to correct the mistakes themselves. He said, "a naval aviator is a unique personality, intensely proud of his accomplishments, and fanatic to a point where his professional reputation is concerned, and this is understandable since it takes infinite patience, nerves of steel, keen intellect and sheer guts to master the highly specialized field of Naval Aviation." CAPT Christiansen said that only after 24 months of gruelling training and experience and about 200 carrier landings can the pilot count himself as one of the elite in Naval Aviation. "You can steal his wife —borrow his money—drink his whiskey—wreck his car and he won't be too upset, but if you criticize his capabilities as a naval aviator he will fight right now, and justly so because he is a rare breed of cat," the captain remarked.

The graduates were reminded that most of their patients are sharp, highly trained gentlemen who engage in a rather hazardous profession. They are principal factors that have ushered carrier aviation into the "mightiest defensive capability that this country, or for that matter, any country in the world has ever seen. In concluding, CAPT Christiansen expressed hope for continued success in the sphere of Naval Aviation through the able assistance of the flight surgeons.

NEW ZEALANDERS VISIT NAVAL AVIATION PHYSIOLOGY TRAINING ACTIVITIES

Squadron Leader L. J. Thompson and Flight Sergeant K. D. Breeze of the Royal New Zealand Air Force spent approximately five weeks visiting U.S. Naval Aviation Physiology Activities. Their visit began upon their arrival at the Naval Aerospace Medical Institute, Pensacola, on 15 March. They were at Pensacola until 9 April 1967 at which time they accompanied the Pensacola group to the Aerospace Medical Association Meeting in Washington. From Washington they travelled to the Marine Corps Air Station, El Toro, to visit the Aviation Physiology unit there.

The primary purpose of their visit was to become indoctrinated in the installation and operation of the Device, 9A9, Altitude-Training Rapid-Decompression Chamber. A chamber of this type was recently

acquired by the New Zealand Air Force. While at Pensacola they were flown to the Naval Air Station, Cecil Field, to visit the 9A9 chamber installation there.

Squadron Leader Thompson is the Flight Surgeon of the New Zealand Air Force. He and Flight Sergeant Breeze are stationed at the Aviation Medicine Unit, Royal New Zealand Air Force Base, Auckland, New Zealand.—NAVAIROSPMEDINST, Pensacola.

GOOD ADVICE FOR SAFETY MANAGEMENT

The Board of Inquiry into the NASA APOLLO fire tragedy made the following general recommendations:

A. Management continually monitor the safety of all test operations and assure the adequacy of emergency procedures.

B. All emergency equipment (breathing apparatus, protective clothing, deluge systems, access arm, etc.) be reviewed for adequacy.

C. Personnel training and practice for emergency procedures be given on a regular basis and reviewed prior to the conduct of a hazardous operation.—

Extracted from: Aviation Week and Space Technology, April 17, 1967. (Ed. Note: Good Advice for *any* test, training or operational program). —AeroMed, BuMed.

AVIATION PHYSIOLOGY TRAINING PRAISED BY VIETNAM PILOT

LT Robert F. Adams, USN, was twice required to eject from his crippled F8 Crusader after being hit over North Vietnam. He was rescued each time and is now on duty in Pensacola, Florida.

LT Adams is an avid booster of the aviation physiological training he had received. In speaking to the graduating class of Aviation Medicine and Aviation Physiology Technicians at the Naval Aerospace Medical Institute in April 1967 he expressed his feelings in this way, (as quoted in the Pensacola News Journal 30 April 1967): . . . "The training I had been given instilled every confidence in the ejection system. Because of my training, my hand went almost automatically through the procedure necessary to get me out of my burning aircraft each time. For myself and the many thousands you and other technicians have trained and will train in the future, I thank You."-NAVAEROSPMEDINST, Pensacola.

FLIGHT SURGEONS PLEASE TAKE NOTE

BUMED Instruction 6120.21 of 17 Feb 1967: Physical Examination of Personnel Assigned to Duty in Vietnam and Adjacent Waters.

Instruction quoted in part:

". . . requirements for annual physical examinations are suspended by this instruction for personnel assigned duty in Vietnam until such time as they are transferred outside that area. *The suspension of this requirement does not apply to aviation personnel* who must continue to receive annual examinations in accordance with reference (b) [MANMED art. 15–60].—AeroMed, BuMed.

SIGNAL VARIANCE AND ITS APPLICATION TO CONTINUOUS MEASUREMENTS OF E.E.G. ACTIVITY

G. H. Byford, Flying Personnel Research Committee, FPRC/1224, May 1964.

This analytical technique provides numerical values which may be used as objective measures of E.E.G. activities. The time scale of the analysis may be so chosen that an E.E.G. record of any duration can be represented by a single graph, on which to the same scale, other associated physical or physiological variables may be recorded. A means is provided for relating time points on the original record with the same time points in the analysis. The method is illustrated by analyses of E.E.G. changes; (a) brought about by anoxia following rapid decompression; (b) during sleep; and (c) following the injection of pentothal and the insertion of sphenoidal electrodes. It has also been used in studies of hyperventilation, changes resulting from increased gravitational stress on a human centrifuge, and of the effect of anaesthetics on arousal patterns in animals.

The E.E.G. signals are divided by filters into five frequency bands approximating the accepted physiological definitions. For each band the signal variance is calculated and the growth of all five variance integrals displayed simultaneously as a set of continuous curves, the slopes of which are measures of activity in the bands. The ratio of any two slopes —the "Variance Index"—may be used as a measure of change between activities in one band at different times, between different bands of the same recording, or between different recordings. The same curves may be used to produce frequency spectra in cases where this approach would be justified; changes in the slope of the variance integral curves

will determine the validity of the spectral analysis approach.

All the operations are carried out on a simple general purpose analogue computer and the results recorded on an XY plotting table or multichannel mirror galvanometer recorder. E.E.G. signals may be analysed "on line"—i.e. as they are recorded—or, by means of a magnetic tape recorder, specific portions of the record can be examined later in greater time or amplitude detail.—From the RAF Institute of Aviation Medicine, Famborough, Hampshire, Ministry of Defence (Air Force).

EDITOR'S SECTION

TO ALL HOSPITAL CORPSMEN

As Surgeon General I extend personal congratulations to every member of the U.S. Navy Hospital Corps on this 69th anniversary of its founding.

The devotion to duty and professional skill being demonstrated by you has won the respect and admiration of military personnel worldwide. Greater demands over the past year have required untold sacrifice, both on the field of battle and in rear echelon support areas. Many of your shipmates have given their lives in support of what they believed to be a most important mission. Numerous others have been wounded, many seriously. For these personnel in particular, words alone cannot express the gratitude and understanding their personal sacrifices deserve.

On behalf of myself and the Navy Medical Department I wish you well.

R. B. BROWN
Vice Admiral MC USN
Surgeon General

RECIPIENT OF THE NAVY LEAGUE'S ADMIRAL CLAUDE V. RICKETTS AWARD

The following is a letter of congratulations from VADM R. B. Brown MC USN to HM1 Richard L. Lewis, USN.

As Surgeon General of the Navy, I wish to extend my personal congratulations as well as those of the Navy Medical Department on your selection as recipient of the Navy League's Admiral Claude V. Ricketts award for leadership and professional competence.

The honor to be bestowed upon you as a result of Navy wide competitive selection the first year of the award is indeed a hallmark in your career. Your record of performance in combat speaks for itself. The inspiring leadership and traditional professional competence you displayed during your recent tour of duty in the Republic of Vietnam were outstanding.

The efficient service hospital corpsmen like yourself have performed over the years is an inspiration to all personnel of the Navy Medical Department. I wish you continued success in your Navy Career—WELL DONE!

SUBMARINE HABITABILITY

The Navy Toxicology Unit is continuing its studies on the toxicity of trace contaminants in nuclear powered submarines. One of the materials of current interest is Dichloroacetylene. This material was originally encountered as a degradation product during anesthesia with Trichloroethylene at which time several deaths were attributed to the decomposition

product formed when Trichloroethylene passed over an absorption agent such as soda lime. Tests have indicated that the 4-hour LC_{50} for Dichloroacetylene in rats is 55 parts per million (ppm) and 15 ppm in guinea pigs. This places Dichloroacetylene in a highly toxic category when compared with a 4-hour LC_{50} for Carbon Tetrachloride of 8,000 ppm and 12,500 ppm for Trichloroethylene.

The presence of Dichloroacetylene aboard submarines has been identified by the Naval Research Laboratory and it is believed that Trichloroethylene, also identified and quantitated, is its precursor. Dichloroacetylene poses a potential health threat to personnel aboard submarines and the Committee on Toxicology of the National Research Council has tentatively recommended that the level be kept below 0.1 ppm.

Studies are underway in which dogs and monkeys, as well as rats and guinea pigs, are being exposed continuously for 90 days in order to develop basic data which more closely simulate submarine conditions.—Public Affairs Office, BuMed.

2,000th MAJOR SURGICAL PROCEDURE

Major Surgical Procedure number 2,001 was a "piece of cake" for the operating room staff aboard REPOSE (AH16). The 2,001th procedure was actually a cake cutting ceremony commemorating the 2,000th major surgical procedure performed 24 March 1967 onboard REPOSE.

The 2,001th procedure was a joint effort by LCDR Albert G. Baily MC USN of Blowing Rock, North Carolina and LCDR Thomas McGeoy, Jr. MC USN of Kensington, Maryland, the same two that performed the 2,000th operation. HM3 L. Federico, Little Falls, New York; HM3 J. Stroehlein, Dunkirk, New York, and HM3 J. R. Wright, III, Berkley, Michigan, were the operating room personnel for the milestone operation.

The ceremony was highlighted by comments from CAPT Rudolph P. Nadbath MC USN, Commanding Officer, Naval Hospital, REPOSE, and CAPT William A. Snyder MC USN, Executive Officer and Director of Surgical Services for the hospital. Also in attendance at the ceremony were various members of the medical and nursing staffs and operating room and ship personnel.

REPOSE has three major surgical operating rooms. There are also two minor surgical operating rooms on the ship. In July 1966 the first open heart surgery was performed at sea onboard REPOSE. The 750 bed hospital arrived in Vietnam in February 1966 and has provided surgical and general medical services for I Corps area.

The Commanding Officer of REPOSE is CAPT R. C. Gossom USNR.—REPOSE (AH16), FPO, San Francisco.

A reprint of the original paper, Antiseptic Principle in the Practice of Surgery, by Lister from the British Medical Journal of 21 September 1867 appears in the 1 April 1967 issue of the same journal (vol 2: 9–12). The original report was read to the Surgical Section of the Annual Meeting of the British Medical Association in Dublin on 9 August 1867.—Editor

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Two articles in the Progress of Medical Science Section of the American Journal of the Medical Sciences for April (Vol. 253) are very informative. The first, The Basophil Degranulation Test, A Review of the Literature, pages 117/473–136/492, is by B. A. Kirshbaum MD, H. B. Cohen MD, Herman Beerman MD, and Thomas Pastras MD, (Department of Dermatology, Hospital of the University of Pennsylvania, Philadelphia, Pa.). The second, pages 137/493–144/500, Serous Otitis Media: A Serious Problem, is by B. J. Soboroff MD, Professor of Otolaryngology, University of Illinois College of Medicine, Chicago, Illinois.—Editor

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