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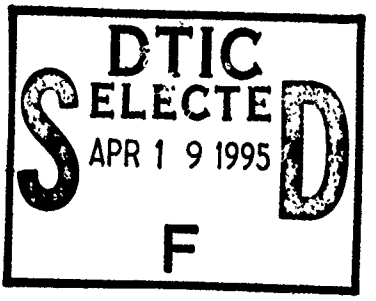
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UNITED STATES ARMY
IN WORLD WAR II



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BRIGADIER GENERAL FRED WHARTON RANKIN

MEDICAL DEPARTMENT, UNITED STATES ARMY

SURGERY IN WORLD WAR II

ACTIVITIES OF SURGICAL CONSULTANTS

Volume I

Prepared and published under the direction of
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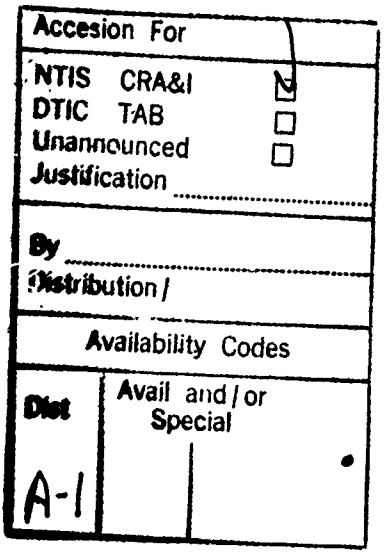
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ACTIVITIES OF SURGICAL CONSULTANTS

Volume I



MEDICAL DEPARTMENT, UNITED STATES ARMY

The volumes comprising the official history of the Medical Department of the U.S. Army in World War II are prepared by The Historical Unit, U.S. Army Medical Service, and published under the direction of The Surgeon General, U.S. Army. These volumes are divided into two series: (1) The administrative or operational series; and (2) the professional, or clinical and technical, series. This is one of the volumes published in the latter series.

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Foreword

This volume, one of the total series that tells the story of the U.S. Army Medical Department in World War II, is the first of two books devoted to the activities of the surgical consultants. It deals with their work in the Office of The Surgeon General; the extension of the system to the Service Commands in the Zone of Interior; and its operation in the U.S. field armies overseas. The second volume, which will appear shortly, deals with activities of the surgical consultants on the theater level in Europe and in the Asiatic-Pacific theaters of war.

Although a skeleton consultant system had operated in the Medical Department in World War I, there was no formal provision for such a system before the outbreak of World War II, and that lack was to plague the consultants throughout the war. It also plagued the command surgeons under whom the consultants worked. Position vacancies were not always available. Lines of authority were not always clear. Questions of rank were often embarrassing. Perhaps most trying of all, consultants overseas were hampered in their activities by the inconvenience and actual inefficiency caused by absence of direct channels of communication between themselves and the consultants in the Office of The Surgeon General. The great convenience of such unofficial channels as were developed made the general deficiency even clearer. In the Zone of Interior, this difficulty did not long exist. Within a very short time, there was close liaison between the consultants in the Office of The Surgeon General and those in the various Service Commands, and standardization of medical care—a wartime necessity—was accomplished more readily, and medical care was more efficient, as a result.

The Professional Services Division that had existed before the war in the Office of The Surgeon General can perhaps be regarded as the predecessor of the World War II consultant system, but its scope was limited and its functions were chiefly administrative. Among its seven subdivisions was the Subdivision of Medicine and Surgery, a combination of specialties so obviously impractical that it made further subdivision inevitable. The appointment of the late Col. (later Brig. Gen.) Fred W. Rankin, MC, as Chief Surgical Consultant to The Surgeon General on 1 March 1942 was shortly afterward followed by the establishment of a separate Surgery Branch, with subdivisions of its own. After other reorganizations, this branch became the Surgical Consultants Division, which operated under, and reported directly to, The Surgeon General.

When Colonel Rankin reported for duty, he found no definition of the functions of a surgical consultant, a deficiency that did not long handicap a person of his dedication and tremendous energy. Nonetheless, many obstacles had to be overcome in setting up necessary positions and otherwise putting the consultant system into operation.

The tacit understanding early in the war was that the consultants were to confine themselves to clinical problems. The understanding was soon abrogated. Before the war ended, the consultants everywhere had extended their activities, with the full approval of those in authority, to a variety of administrative considerations, of which the assignment of professional personnel on the basis of evaluation of their experience and ability was probably the most important.

Early in the war, the assignment of newly commissioned medical officers by the Office of The Surgeon General and other responsible headquarters was necessarily somewhat arbitrary. Those responsible for this function usually had only paper qualifications to work with, and paper qualifications, even when there is every attempt to make the presentation honest and objective, can never tell the full truth. The consultants, handpicked themselves, in turn hand picked key personnel in their areas of jurisdiction. Fresh from peacetime practice, they personally knew the capacities of many of the physicians who were entering military service, and when they did not know the new officers personally, they had ways of finding out about their abilities.

The consultants in the Office of The Surgeon General recommended the appointment of the consultants for Service Commands in the Zone of Interior and for oversea theaters and field armies; for the surgical staffs of hospitals; and for the newly organized auxiliary surgical groups, whose important role in forward surgery they correctly predicted. How well the consultants performed this particular mission is evident in the analysis made in 1945, by General Rankin, of the assignment of 922 surgical specialists. Exclusive of the 37 who were serving as consultants in the Office of The Surgeon General or in the Service Commands and elsewhere, 96 percent were engaged in practicing their own specialties and were considered to be correctly assigned.

Among the other functions performed by the surgical consultants in the Office of The Surgeon General in the initiation and extension of the consultant system were the following:

They revised the equipment lists, eliminating outmoded instruments and apparatus, providing new items, and equalizing distribution.

They pressed for the establishment of specialized surgical centers and implemented the concept. These centers utilized most efficiently the always limited number of surgical specialists; utilized equipment with equal economy; and constantly improved the treatment of casualties by concentrating those with the same kinds of injuries in the same hospitals and thus providing continued, concentrated experience for the surgeons who treated them.

The consultants in the Office of The Surgeon General set up central supply services in hospitals. They supervised programs of medical education. They saw to it that libraries were provided with books and journals. They made regular hospital staff conferences mandatory. They organized meetings on general and special problems. They prepared circular letters. They commented on the ETMD's (Essential Technical Medical Data reports) from the

theaters of combat, thus providing at least a tenuous link of communication between themselves and the consultants overseas. They tried, unsuccessfully, to set up a similar series of reports in the Zone of Interior.

The Surgical Consultants Division, Office of The Surgeon General, planned various clinical studies, including those on penicillin and streptomycin. It analyzed special problems such as hernia, varicose veins, and pilonidal sinuses. The consultants in surgery in the First Service Command collected and analyzed 594 operations for pilonidal sinus; within a very short time, as a result, the management of this condition was completely altered.

The work of the surgical consultants in the Service Commands, the oversea theaters, and the field armies followed the same patterns of endeavor as those just described, adapted, as necessary, to the special conditions which each consultant had to meet. Their activities in these armies were of major importance. It was in the forward areas that initial wound surgery was performed and, very frequently, determined the end result of an injury in terms of survival, morbidity, or permanent deformity versus complete restoration to normal. The chapters in this volume dealing with the work of Army consultants deserve the most careful reading.

This volume tells, in summary, the dramatic story of the blood program in World War II. (It is told in detail in another volume in this series.) This story is a frank and forthright narrative, which makes clear that very few can escape the blame for unthinking acceptance of the original misleading concept that plasma is a satisfactory substitute for whole blood. This volume also tells other stories: The story of the aural rehabilitation program and of the program for the rehabilitation of blinded casualties (both told in detail in another volume in this series); the story of the development of prosthetic devices for amputees and of the rehabilitation of these men; and, finally, the story of the preparation for chemical warfare, which, mercifully, never came to pass.

This book describes frankly and realistically the difficulties encountered, and the obstacles that had to be overcome, by the surgical consultants in all areas as they set about their tasks. Some of their troubles arose, it must be granted, because of their own inexperience in military matters. But more of them stemmed from an initial failure to appreciate the potentials and implications of this new system. Most of the consultants, from their own peacetime clinical experience, correctly envisaged their own functions, and, because they were imaginative, resourceful, and willing, they were soon able to translate peacetime concepts to wartime actualities. They sometimes had to school themselves, at least at first, to working in headquarters and organizations that were at best indifferent and that sometimes were frankly hostile. It is a tribute to the tact of the consultants as well as to their competence that the original opposition to them promptly disappeared and that the consultant system spread from a few commands in the Zone of Interior to oversea theaters and to field armies. It is an even greater tribute to their work that in the areas in which the consultant system did not operate, the desire for it was repeatedly expressed.

The consultants performed many functions, but they never lost sight of the fact that their first duty was the provision of good medical care for wounded casualties. The importance of this mission requires no elaboration. Its success is best estimated in terms of lives saved and in the decreased mortality and generally normal status of those who survived their injuries—their often incredibly severe injuries.

I am impressed, as I have been in all previous volumes of this historical series, by the amount of factual material in this volume; by the frankness with which the story is told; and by the interest which it holds for readers, even readers who, of necessity, already know a great deal about it. The consultant system was wonderfully successful, and we have reason to be thankful that it is now an integral part of medical care in the Regular peacetime Army and an important component of the professional training program of the Army Medical Service.

As the editor of this volume has stressed in his preface, there could not have been a more felicitous choice for the post of Chief Surgical Consultant to The Surgeon General than the late Brig. Gen. Fred W. Rankin. He came to his military duties with a fine background of personal surgical competence and experience and with the deep respect of his confreres. Widely informed on the personnel to be assigned, he insisted that they be placed on the basis of their ability and experience. He recognized the major problems of surgical care without ever becoming lost in their trivia. He slashed through administrative complications. His standards were undeviating. When his personal convictions were at stake, he was completely undeterred by rank. The remarkable success of the surgical consultant system stemmed in large measure from his own personal performance in the Office of The Surgeon General.

The contributors to this volume deserve thanks for taking on the task. As its editor points out, they were willing to undertake it because they realized that the consultant system was responsible to a major degree for the surgical advances in the care of wounded casualties in World War II and therefore must be recorded for practical clinical reasons as well as for historical reasons.

I express my gratitude to the consultants who wrote this story and who helped to accomplish the achievements related in this volume and in the volume to follow; to the editors, particularly the special editor for these two volumes, the former Col. B. Noland Carter, MC; and to my associates who are helping me to carry out one of the truly important missions of my own office, the preparation and publication of this history of the U.S. Army Medical Department in World War II.

LEONARD D. HEATON,
Lieutenant General,
The Surgeon General.

Preface

In 1953, The Surgeon General and his advisory committee on the Medical History of World War II decided that such a history would not be complete without a volume devoted to the surgical consultant system. A panel was therefore appointed to implement and expedite the publication of such a volume. Great credit is due the many men who served as surgical consultants in World War II for their cheerful acceptance of the responsibility of contributing to this volume so many years after the completion of their military duties. In order to refresh their memories, it was necessary for them to delve into reports long since hidden in their own files or in those in the Office of the Surgeon General. Their willingness to do so stemmed in large part from their feeling, in which I concur most heartily, that the surgical consultant system in World War II was effective and responsible in large measure for the remarkable surgical achievements in the care of the sick and wounded and therefore should be recorded for historical as well as practical reasons. There is every reason for these men to feel proud of their accomplishments in World War II. Their efforts constituted a real factor in the success of the surgical results that were obtained and which were responsible for the maintenance of the efficient and smoothly functioning surgical services supplied to the Army.

There is an obvious need for capable surgeons in the role of consultants in times of war. When the civilian medical profession is called upon to furnish surgeons to the Army, individuals of widely varying degree of competence offer their services. It is difficult for the military authorities to evaluate the true qualifications of the members of such a large and diverse group. They are apt to feel that a doctor with the designation of surgeon can perform any medical or surgical duty and therefore can be assigned with impunity to any position which calls for a surgeon. In fact, this same feeling may be applied to doctors in general, regardless of their specialized training, so that one might find a well-qualified surgeon holding sick call while a general practitioner with little or no surgical experience might be occupying a surgical position. The handpicked surgical consultant, however, who is interested in building and maintaining an efficient organization in the area under his jurisdiction can ascertain what surgeons are available to him, can sort them according to their qualification and experience, and can arrange for their proper assignment. The classification and suitable assignment of surgical personnel is, I believe, the most important function of the consultant. By placing the proper man in the proper place, one is able to build an organization which will function in the most efficient manner. Such a procedure promotes morale and, in utilizing the individual talents of the surgeons under one's jurisdiction, affords the best surgical care to the sick and wounded.

It is not only imperative that the newer methods of treatment be made available to the surgeons throughout the Army framework but also that strict adherence to those surgical procedures which have been found most effective be enforced. These objectives can best be accomplished by the consultant and, next to his handling of personnel, constitute the most important part of his duties. With his knowledge of what is happening in his area, the consultant is well suited for the furtherance of public relations and for liaison within his headquarters, with the Office of the Surgeon General, with civilian surgeons, and with other consultants. He can and should be interested in the training and education of the surgeons under his authority. Surgical meetings can be organized at which discussions are held on the proper management of pertinent cases, papers can be read, and the current literature reviewed. The consultant has the duty also of reviewing manuscripts prepared in his area for publication in surgical journals. Still another function of the consultant is to survey the equipment and supplies of various installations and to insure that the facilities with which to function in a proper manner are made available. These functions are merely a few of the more important ones which the surgical consultants performed in World War II. Many others are revealed in the chapters of these volumes. The consultant system in World War II was begun on a small scale and, owing to the excellent results which it produced, was steadily expanded until it reached the furthermost parts of the Medical Department within the Army. The surgical consultant system gained in stature as the war progressed and emerged as an important cog in the machine which was manned by the thousands of surgeons who gave of themselves so unselfishly in the war effort.

It is said, and I believe rightly so, that medical histories of wars are rarely read, even in wartime. It is to be hoped that such a fate will not befall this volume, for it contains much of interest, particularly to those who may in the future become a part of a surgical consultant system. The men who have contributed to it hope that the account of their efforts and their experiences will not escape the attention of their successors and will prove of value to them.

An account of the activities of surgical consultants in World War II would not be complete without special mention of the role which Brig. Gen. Fred W. Rankin, Chief Consultant in Surgery to The Surgeon General, played in contributing to the success of the consultant system. He was unusually well fitted for his position in that he possessed certain attributes which enabled him to accomplish his mission in a most effective manner. His wide knowledge of the personalities and capabilities of a large number of American surgeons made it possible for him to assign accurately suitable individuals to key positions within the structure of the surgical consultant system. His early recognition of and his continued stress on the importance of the proper placement of personnel cannot be overemphasized. He repeatedly stated during the war that his most effective means of providing the highest standards of surgical care for the sick and wounded was to put the right man in the right place. He had

an uncanny ability to recognize important problems and to approach them directly while disregarding the insignificant details. He had tremendous determination, was never overawed by rank, and stood fast to those principles which he considered to be just and right. He hated redtape and was unswerving in his efforts to cut through it to further the prosecution of the war. He was an inspiring leader and one who constantly espoused the highest principles of his profession.

B. NOLAND CARTER, M.D.

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Part I

SURGICAL CONSULTANTS IN THE ZONE OF INTERIOR

Surgical Consultants in the Office of the Surgeon General

CHAPTER I

General Surgery

B. Noland Carter, M.D.

At the onset of the war, the Professional Service Division of the Office of the Surgeon General consisted of seven subdivisions among which was the Medicine and Surgery Subdivision.

It was soon realized that, in order to carry on the medical and surgical activities of the Office of the Surgeon General in an adequate fashion, it would be necessary to create a separate organization for each. Therefore, in February 1942, a chief consultant in surgery, Col. (later Brig. Gen.) Fred W. Rankin, MC, and his opposite in medicine, Col. (later Brig. Gen.) Hugh J. Morgan, MC, were placed in charge of their respective and separate branches. In March 1942, the Surgery Branch of the Medicine and Surgery Subdivision became the Surgery Division, functioning as an integral part of the Professional Service and comprising subdivisions of general surgery, orthopedic surgery, regional surgery, chemical warfare, and radiology. In August 1942, another reorganization within the Professional Service was effected whereby surgery became a branch under a Medical Practice Division. This situation remained until June 1943 when the Surgery Branch became the Surgical Division with its functions divided among three branches, the Surgery, Radiology, and Physiotherapy Branches. This new plan also provided that nationally known specialists would be appointed as civilian consultants to The Surgeon General so that their services would be available to the divisions having interest in and need for expert consultation in the fields represented. By February 1944, the Surgery Division (formerly the Surgical Division and still a part of Professional Service) consisted of branches in general surgery, orthopedic surgery, transfusions, chemical warfare, and radiation—physiotherapy having been eliminated. In August 1944, the Surgery Division became the Surgical Consultants Division,[1] was separated completely from the Professional Service, and was set up as an advisory staff division on a separate level from the operating services in the Office of the Surgeon General. From this time until the end of the war,

[1] The Surgical Consultants Division underwent a series of evolutional changes in status during the years 1942–45 On 26 March 1942, the Surgery Division was created as a part of Professional Service, Office of the Surgeon General. On 24 August 1942 the Surgery Division was changed to the Surgery Branch, Medical Practice Division, Professional Service. On 15 June 1943 the unit became a division again with the designation Surgical Division, and on 3 February 1944 it became the Surgery Division. On 24 August 1944 the Surgery Division became the Surgical Consultants Division, responsible directly to The Surgeon General, and on 11 October 1945 the name was changed again to Surgical Consultants. For ease of reference, the designation Surgical Consultants Division is used for the unit throughout this volume.

the Surgical Consultants Division reported directly to The Surgeon General. Thus, it may be seen, the surgical activities in the Office of the Surgeon General began as a part of the Medicine and Surgery Subdivision, steadily widened in scope, and ultimately became a large and independent division directly under The Surgeon General (fig. 1).

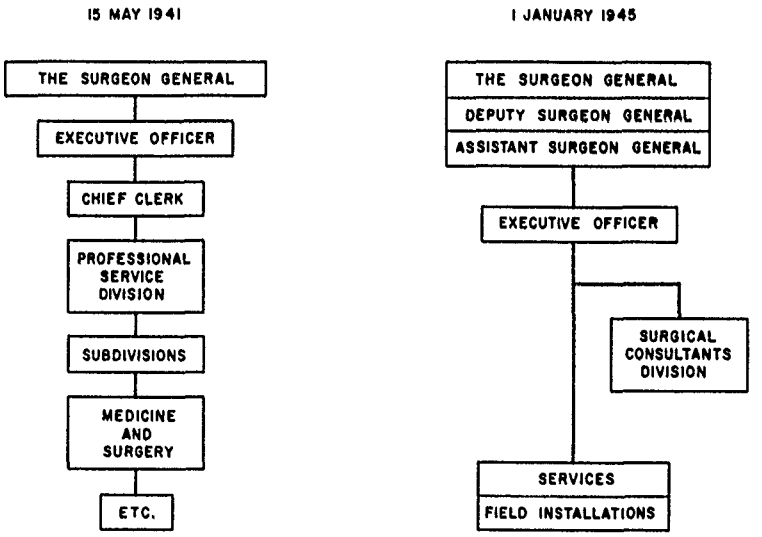


FIGURE 1.—The position of Surgical Consultants Division in the organization of the Office of the Surgeon General.

At its inception in February 1942, the Surgical Consultants Division was housed in two small rooms, and its personnel consisted of Colonel Rankin, Chief Consultant; Lt. Col. (later Col.) B. Noland Carter, MC, Assistant Chief (fig. 2); and Maj. (later Lt. Col.) Ambrose H. Storck, MC. As the war went on and the demands on the Division increased, additional officers were added. These were Col. Leonard T. Peterson, MC, Consultant in Orthopedics; Col. Byrl R. Kirklin, MC, Consultant in Radiology; Lt. Col. M. Elliott Randolph, MC, Consultant in Ophthalmology, succeeded later by Col. Derrick T. Vail, MC; Lt. Col. Leslie E. Morrissett, MC, Consultant in Otolaryngology, succeeded by Col. Norton Canfield, MC, late in 1945; Lt. Col. Douglas B. Kendrick, Jr., MC, and Lt. Col. Frederic N. Schwartz, MAC, Consultants in Transfusions; Maj. Albert M. Johnston, MC, and, later, Maj. George R. Greenwood, MC, Consultants in Chemical Warfare; and Maj. R. Gordon Holcombe, MC, Consultant in General Surgery. The following officers from Walter Reed General Hospital were appointed on a part-time basis: Lt. Col. Brian B. Blades, MC, Consultant in Thoracic Surgery; Col. R. Glen Spurling, MC, Consultant in Neurosurgery, replaced later by Lt. Col. Barnes Woodhall, MC; and Maj. Lloyd H. Mousel, MC, Consultant in Anesthesia. Colonel Storck left the Division after several



FIGURE 2.—Lt. Col. (later Col.) B. Noland Carter, MC, Assistant Chief, Surgical Consultants Division, Office of The Surgeon General.

months and was replaced by Maj. (later Lt. Col.) Michael E. DeBakey, MC, who, on the departure of General Rankin in September 1945, became the chief of the Division.

The men who were appointed as civilian consultants to The Surgeon General to serve the Surgical Consultants Division are listed, with their area of specialization, in appendix A.

FUNCTIONS

The functions of the Surgical Consultants Division of the Office of the Surgeon General were defined in various terms in directives issued from time to time during the war. The following are examples of these definitions: "Promulgates policies concerning the practice of general specialized surgery and radiology throughout the Army"; "The development of surgical policies

including newer methods of treatment and the initiation of recommendations regarding same; renditions of professional opinions as to miscellaneous surgical methods; approval by liaison with the Personnel Division of selection of personnel for key positions; formulation of policies concerning the purchase of new drugs and items of equipment for the Medical Department, and consideration of ideas submitted by individuals, institutions and manufacturers"; and "To exercise general supervision of surgical care throughout the Army, afford consultation and advice to all departments of the Surgeon General's Office on matters pertaining to surgery and to assist in the identification and proper allocation and assignment of qualified commissioned surgical specialists." The various functions of the Surgical Consultants Division can best be outlined and presented under the headings of personnel, equipment and supplies, public relations and liaison, review of manuscripts and literature, education and training, and consultation.

PERSONNEL

The maintenance and elevation of high standards of surgery in the Army were considered by the Surgical Consultants Division to be dependent upon a number of factors, among the most important of which was the accurate placement of personnel, particularly of key personnel. The Division therefore took an active and zealous interest in the selection and recommendation of personnel for the various surgical positions which it was necessary to fill throughout the structure of the Medical Department. This was accomplished by various means. Some selections were made through personal interviews or correspondence with civilian surgeons who had themselves manifested a desire for an appointment in the Medical Corps, some were carried out through consultation with representatives of the specialty boards, and some were accomplished after consultation with the Military Personnel Division concerning professional qualifications and appropriate assignment of officers recently commissioned. It was believed that, if key positions could be filled with individuals with proper professional qualifications and with proven ability for organization and supervision, the enormous problem of affording the best care of the surgically sick and wounded would be solved in large part. This surmise proved to be correct, as was evidenced by the superior manner in which the varied surgical activities were administered by those men who had been selected for positions of importance, such as consultants, chiefs of service, and members of auxiliary surgical groups. At the very beginning of the war, it was somewhat difficult to perform this personnel function readily since the accepted lines of authority as to personnel assignment were rather rigidly drawn. The Military Personnel Division, however, with the understanding direction of Col. (later Maj. Gen.) George F. Lull, MC, soon grasped the fact that the Surgical Division possessed extremely accurate information concerning the qualifications of many surgeons and therefore cooperated heartily and effectively. The importance of this personnel function was realized by Maj. Gen.

Norman T. Kirk, MC, soon after he became The Surgeon General in June 1943. General Kirk decreed that the identification and proper allocation of surgical specialists was to be a function of the Surgical Consultants Division. Having selected a man for a position of importance, the Surgical Consultants Division purposed to support him in the performance of his duties in every way. This was more readily accomplished in the Zone of Interior than in oversea theaters of operations, which tended to function independently of the Office of the Surgeon General.

Consultants to Oversea Theaters

As requests for consultants in surgery and its allied specialties were received from the various theaters of operations, it was obvious that these consultants had to be highly qualified and unusually competent individuals with special training and a broad background of experience as well as eminent reputations in their fields of endeavor. It was the important responsibility of the Surgical Consultants Division to select and to recommend these consultants, all of whom were chosen according to these criteria. The first group of consultants was selected for the European Theater of Operations and consisted of the following:

Chief Consultant in Surgery	Lt. Col. (later Brig. Gen.) Elliott C. Cutler, MC, Moseley Professor of Surgery at Harvard University.
Consultant in Orthopedics	Lt. Col. (later Col.) Rex L. Diveley, MC, associate professor of orthopedic surgery, University of Kansas, Lawrence, Kans., succeeded by Col. Mather Cleveland, MC.
Consultant in Neurosurgery	Lt. Col. (later Col.) Loyal Davis, MC, professor of surgery, Northwestern University, Evanston, Ill., succeeded by Lt. Col. (later Col.) R. Glen Spurling, MC, professor of neurosurgery, University of Louisville.
Consultant in Ophthalmology	Lt. Col. (later Col.) Derrick T. Vail, MC, professor of ophthalmology, University of Cincinnati, succeeded by Lt. Col. James N. Greear, Jr., MC.
Consultant in Anesthesia	Lt. Col. (later Col.) Ralph M. Tovell, MC, chairman of the Department of Anesthesiology, Hartford Hospital, Hartford, Conn.
Consultant in Otolaryngology	Lt. Col. (later Col.) Norton Canfield, MC, professor of otolaryngology, Yale University.
Consultant in General Surgery	Lt. Col. Ambrose H. Storck, MC, succeeded by Lt. Col. (later Col.) Robert M. Zollinger, MC, associate professor of surgery, Harvard University.
Consultant in Plastic Surgery	Lt. Col. (later Col.) James Barrett Brown, MC, associate professor of clinical surgery, professor of oral surgery, Washington University, St. Louis, Mo., succeeded by Maj. (later Lt. Col.) Eugene M. Bricker, MC, assistant professor of surgery, Washington University.

A short time after NATOUSA (North African Theater of Operations, U.S. Army) was established, Col. Edward D. Churchill, MC, Homans Professor of Surgery at Harvard University, was selected as chief consultant in surgery for that command. The other surgical consultants in that theater were appointed by the Surgeon, NATOUSA, on the advice of Colonel Churchill.

The situation in the Pacific cannot be so easily stated owing to the fact that there was no single Pacific theater as such and also to the many reorganizations which took place among the various commands. Without reference from the Office of the Surgeon General, Lt. Col. (later Col.) August W. Spittler, MC, had been designated surgical consultant in the Hawaiian Department at the beginning of the war. Col. W. Barclay Parsons, MC, associate professor of surgery, Columbia University, was the first to be selected specifically for assignment to the Pacific as a surgical consultant. He served in the early years of the war with USASOS, SWPA (U.S. Army Services of Supply, Southwest Pacific Area), until replaced by Lt. Col. (later Col.) I. Ridgeway Trimble, MC, in August 1944. Serving with Colonel Trimble was Lt. Col. George O. Eaton, MC, Orthopedic Consultant, USASOS, SWPA. Both Colonel Trimble and Colonel Eaton were later assigned to the staff of USAFPAC (U.S. Army Forces, Pacific)—the eventual overall command for most of the Army in the Pacific.

In the South, Central, and Western Pacific areas, which at one time or another operated under Headquarters, USAFMIDPAC (U.S. Army Forces in the Middle Pacific), Headquarters, USAFPOA (U.S. Army Forces in the Pacific Ocean Areas), and Headquarters, USAFPAC, Lt. Col. (later Col.) Forester Raine, MC, was the surgical consultant for the Central Pacific with Lt. Col. (later Col.) Robert C. Robertson, MC, as his orthopedic consultant. Lt. Col. (later Col.) Ashley W. Oughterson, MC, associate professor of surgery, Yale University School of Medicine, had gone to Auckland, New Zealand, with the 39th General Hospital and was appointed surgical consultant to the South Pacific Area, in July 1943. Colonel Oughterson later served as surgical consultant at Headquarters, USAFPOA, Western Pacific Base Command, and at Headquarters, USAFPAC. He went to Japan in September 1945 with advanced headquarters, General Headquarters, USAFPAC, and was immediately made head of the General Headquarters, USAFPAC group of the Joint Commission for the Investigation of the Effects of the Atomic Bomb in Japan. Maj. (later Col.) Howard A. Sofield, MC, replaced Colonel Oughterson as surgical consultant in the South Pacific and was, himself, relieved by Lt. Col. (later Col.) Willis J. Potts, MC. Lt. Col. (later Col.) Edward J. Ottenheimer, MC, replaced Colonel Oughterson in the Western Pacific Base Command.

In the meanwhile, Col. John B. Flick, MC, had been sent as surgical consultant to the U.S. Army Forces in the Middle Pacific when that command was established as a superior command over the South, Central, and Western Pacific

base commands. There were others who, from time to time, were detached from their organizations and served as consultants for particular studies or specific operations. Still others were appointed as consultants in the various subcommands of the sprawling Pacific areas following the surrender of Japan.

Col. Stephens Graham, MC, assistant professor of surgery, Medical College of Virginia, was selected as chief consultant in surgery to the China-Burma and India theaters in 1945.

All of these consultants shouldered their great responsibilities in a most commendable manner. By their assiduous and unrelenting attention to their many personnel problems and to their varied professional duties, they were responsible in large measure for the type of surgical treatment which saved more lives in this war than in any other conflict in the history of the world. Constant vigilance for methods of implementing better and earlier surgery, unfailing devotion to their diverse duties, and determined efforts to reduce mortality and morbidity characterized the activities of these officers. The valuable role which they played in the maintenance of a high standard of surgery cannot be overemphasized.

As the war progressed, it became evident that, under the existing circumstances, close liaison between these officers and the Office of the Surgeon General was extremely difficult and at times impossible. In order that The Surgeon General might be acquainted with, and therefore assist in solving in the most expeditious and intelligent manner, the many problems arising in oversea theaters, the reports known as Essential Technical Medical Data were instituted. The inclusion of a surgical section in this monthly communication from the headquarters of all oversea theaters afforded a medium through which the surgical consultants of these theaters were able to consider timely and pertinent subjects with the Surgical Consultants Division of the Office of the Surgeon General. Replies to these reports were formulated each month, indicating the action which was taken by the Division, in an effort to aid in the improvement of surgical care in the theaters of operations. These reports constituted one of the most valuable sources of information concerning the surgical experiences of oversea units. For this reason the Surgical Consultants Division took pardonable pride in its role in the development of this medium for obtaining information on current medicomilitary problems in the oversea theaters and in contributing to their solution.

In retrospect, one of the most serious defects in the maintenance of the most effective relations between the Office of the Surgeon General and the theaters of operations was the lack of a closely knit liaison which can best be had by an interchange of personnel. Considerably better teamwork could have been effected had there been more frequent visits by members of the Surgical Consultants Division to the various theaters, and vice versa. Many more problems could have been solved in a more effectual and expeditious manner had

such a scheme been instituted. In retrospect, it seems unbelievable that during the entire war only two visits were made to foreign theaters of operations by members of the Division and that only a few more were made by surgical consultants from oversea theaters to the Office of the Surgeon General. It should be noted that a considerable number of subordinate consultants in the various specialties were appointed within the theaters by the chief surgeons with the advice of the surgical consultants.

Surgical Consultants to Service Commands

On 28 July 1942, the War Department authorized the appointment of surgical consultants to be attached to the medical section of each service command headquarters in the Zone of Interior. These consultants were concerned essentially with the maintenance of the highest standards of surgical practice. Their function was to evaluate, promote, and improve the quality of surgical care by every means and to interpret the professional policies of The Surgeon General and aid in their implementation. The proper performance of these functions involved an appraisal of the professional services in various medical installations, the quality, distribution, and assignments of professional personnel, the availability and suitability of equipment and supplies, the nursing care, recreational and reconditioning facilities, and other services which were essential to the welfare and morale of the patients. The consultants exercised their functions by assisting and advising the service command surgeons on all matters pertaining to professional practice, providing advice on surgical subjects in general, stimulating interest in professional problems, aiding in the investigation of professional problems, and encouraging educational programs. The execution of these functions involved periodic visits to all medical installations and other units in the command which were concerned with the surgical care of military personnel.

It became apparent from these considerations that the service command consultants would need to be highly qualified and unusually accomplished individuals with special training and experience and eminent reputations in their individual fields of endeavors. The selection and recommendation of these consultants were made the responsibility of the Surgical Consultants Division, and all of them were chosen according to these criteria. Here, as in many other situations which required the selection of an outstanding individual for an important surgical position, a personal knowledge of and an acquaintance with the majority of the qualified American surgeons was essential. The Surgical Consultants Division was thus equipped, and its choice of service command consultants was more than justified by the manner in which they performed their duties, the industry and zeal which they manifested, and the high standards of surgery which were maintained in Army hospitals under their jurisdiction.

A list of the service command surgical consultants follows:

Service Command	*General Surgery*	*Orthopedics*
First	Col. Condict W. Cutler, Jr., MC	
Second	Col. Stephens Graham, MC	
	Col. Robert H. Kennedy, MC	
Third	Col. Walter D. Wise, MC	
Fourth	Col. Rettig Arnold Griswold, MC	Col. Mather Cleveland, MC
	Col. I. Mims Gage, MC	Lt. Col. James J. Callahan, MC
Fifth	Col. Claude S. Beck, MC	Lt. Col. Robert L. Preston, MC
Sixth	Col. W. Barclay Parsons, MC	Lt. Col. Ralph Soto-Hall, MC
Seventh	Col. Grover C. Penberthy, MC	
Eighth	Col. Bradley L. Coley, MC	Col. Thomas L. Waring, MC
	Col. Henry G. Hollenberg, MC	
Ninth	Col. John B. Flick, MC	Col. John J. Loutzenheiser, MC
	Col. Meredith G. Beaver, MC	

Liaison between the service command consultants and the Surgical Consultants Division of the Office of the Surgeon General was adequately maintained throughout the war. The advantage of the geographic factor in this relationship is obvious. Frequent visits to the nine service commands were easily and frequently made by the staff of the Surgical Consultants Division, and on most of these visits the staff were accompanied by the service command consultant. Telephone calls could be made without much difficulty, and correspondence could be exchanged without delay. The service command surgeons, the commanding officers of hospitals, and the surgical consultants were in and out of the Office of the Surgeon General constantly. Unquestionably, this ready liaison was responsible for much of the efficiency with which both organizations were able to function. Another even more important factor was that the service commands were under the direct control of the Commanding General, Army Service Forces, on whose staff was The Surgeon General. Therefore, the implementation of directives—both professional and administrative—was readily effected, personnel changes could be quickly and accurately made, and a healthful, cooperative attitude engendered. In striking contrast to this satisfactory liaison was that with the oversea theaters. As mentioned before, it was rare for consultants overseas to visit the Office of the Surgeon General and vice versa, correspondence had to be through command channels, and the theaters were quite autonomous, with the result that interference, real or implied, was actually resented.

As a means of effecting a closer liaison with the service command consultants, General Rankin, in October 1943, arranged a meeting of the service command consultants in the Office of the Surgeon General. The meeting lasted for 2 days, during which time many pertinent problems common to all service commands were discussed informally, presented frankly, and solved realistically. Among these were questions dealing with limited service, operating on defects existing before induction, operations on the knee joint, discharge, classification and assignment of personnel, anesthesia, types of cases to be admitted

to station and general hospitals, hours of duty for medical officers, et cetera. The consultants thus had the opportunity to present their achievements as well as their problems, and to discuss them at first hand with members of the Office of the Surgeon General and with their fellow consultants. The meeting was considered to be such a success that it was decided that similar ones would be held at yearly intervals during the remainder of the war.

A second meeting was held on 10–11 October 1944, in the Office of the Surgeon General (fig. 3). At this time a more comprehensive program was presented, an outline of which follows.

10 October 1944:

Subject	*Speaker*
Demobilization Plans as They Affect the Service Commands	Col. Arthur B. Welsh, MC
Transfer of Patients From Debarkation Hospitals	Lt. Col. John C. Fitzpatrick, MC
Hospitalization Problems	Dr. Eli Ginzberg
Classification and Assignment of Personnel	Maj. Robert Evans
Reconditioning	Col. Augustus Thorndike, MC
Surgery in the Army Air Forces	Lt. Col. Alfred R. Shands, MC
Problems in X-Ray	Col. Byrl R. Kirklin, MC
Photography in the Medical Department	Capt. Ralph P. Creer, MAC
Problems of CDD (Certificate of Disability for Discharge) and Retirement	Col. Arden Freer, MC
Cancer in the Army	Col. R. Arnold Griswold, MC
History of Surgery in This War	Lt. Col. Michael E. DeBakey, MC
Monthly Statement From the Surgical Service in Each Hospital of the Service Command to the Consultant	Col. Walter D. Wise, MC
Anesthesia in the Service Commands	Col. John B. Flick, MC

11 October 1944:

Subject	*Speaker*
Injuries to Carpal, Navicular, and Lunate	Maj. Ralph Soto-Hall, MC
Management and Disposition of Cases of Knee Injury	Lt. Col. Robert L. Preston, MC Maj. James J. Callahan, MC
Varicocele and Undescended Testis	Lt. Col. Stephens Graham, MC
Phlebothrombosis and Pulmonary Embolism	Col. Bradley L. Coley, MC
Closure of Colostomy Wounds	Col. Claude S. Beck, MC
Ophthalmology and the Blind	Maj. M. Elliott Randolph, MC
The Deaf	Maj. Leslie E. Morrissett, MC
Management and Disposition of Cases of Herniated Nucleus Pulposes	Col. Grover C. Penberthy, MC, and Maj. Barnes Woodhall, MC
Use of Penicillin in Reconstructive Surgery	Lt. Col. Thomas L. Waring, MC
Infected Hands and Hand Injuries	Lt. Col. Condict W. Cutler, Jr., MC
The Management of Decubitus Ulcers	Col. I. Mims Gage, MC

The service command consultants were active in insuring the best care and a rapid turnover of the thousands of patients as they were evacuated to the United States from oversea theaters. They maintained an exceedingly high level of professional care in the medical installations within the Zone of Interior. They unified and implemented the interpretation of the professional policies stated

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FIGURE 3.—Service Command surgical consultants at their meeting with General Rankin and his staff, 10–11 October 1944, in The Surgeon General's office, 1818 H Street NW., Washington, D.C. Front row (left to right): Col. John B. Flick, Col. B. Noland Carter, Col. I. Mims Gage, Brig. Gen. Fred W. Rankin, Col. W. Barclay Parsons, Col. Bradley L. Coley, Col. Grover C. Penberthy. Back row (left to right): Maj. R. Gordon Holcombe, Lt. Col. James J. Callahan, Col. Thomas L. Waring, Col. Claude S. Beck, Col. Walter D. Wise, Lt. Col. Condict W. Cutler, Jr., Lt. Col. Robert L. Preston, Lt. Col. Ralph Soto-Hall, Lt. Col. Stephens Graham, Col. John J. Loutzenheiser, Lt. Col. Michael E. DeBakey, Lt. Col. A. R. Shands, Col. Byrl R. Kirklin.

by the Office of the Surgeon General. Their contribution to the care of surgical patients was more than rewarding, and their devotion to their difficult and diverse duties was inspiring.

Auxiliary Surgical Teams

In the early days of the war, the Surgical Consultants Division recognized the potential of the auxiliary surgical groups as a means of bringing definitive surgical care to the seriously wounded in the forward areas, especially when the load of battle casualties was too great to be handled adequately by the staffs of existing medical treatment facilities. Particular interest was therefore taken in expediting the formation of these groups and in the selection of personnel for the various specialized surgical teams which composed the groups. These groups included teams of general surgeons, neurosurgeons, thoracic surgeons, plastic surgeons, orthopedic surgeons, and anesthesiologists. During the fiscal year ending 30 June 1943, the Surgical Consultants Division selected and recommended the personnel for the various teams of four complete auxiliary surgical groups and for a portion of a fifth. An immense amount of time was consumed in the selection of medical officers to fill these teams. It was considered of fundamental importance that they be staffed with well-trained specialists since they were destined to afford the highest type of surgical care to the wounded in the forward areas. How adequately this was accomplished is indicated by the fact that each officer selected had had an average period of surgical training of from 3 to 6 years.

These groups, though they were not accepted readily at first by the theaters to which they were assigned and not utilized to the best advantage until later, proved to be of the greatest value. The concept of bringing well-trained surgeons to the seriously wounded, rather than the older one of evacuating the casualties far to the rear for definitive surgical care, was logical and sound. There is little doubt that the adoption of this concept was a potent factor in the reduction of mortality and morbidity among the wounded.

Surgical Consultants to Field Armies

Further evidence of the Surgical Consultants Division's conviction that the establishment of a consultant system was of the first importance in the proper handling of casualties throughout the Army was its interest in recommending and in implementing the appointment of suitably qualified individuals as surgical consultants to the various field armies. These positions called for well-trained surgeons who combined a high degree of professional ability with energy, enthusiasm, and the ability to handle difficult situations in a tactful yet firm manner. When one considers that a field army has as its components those medical treatment facilities which give initial surgical care to the wounded, one can appreciate the need for skillful supervision of the manner in which such care should be given. The theater consultant's responsibility

included the field armies within the theater, but those consultants could not be familiar with the many problems which arose within each army, nor could they have the time and opportunity to assist in solving them. On the other hand, the army consultant lived closely with such problems, could give them individual attention, and, being a member of the medical section at army headquarters, was in the best position to provide a solution for them. In the majority of instances the army consultants were selected by the Surgical Consultants Division. They were as follows:

Army	*Consultant*
	In Europe
First	Col. J. Augustus Crisler, Jr., MC
Third	Col. Charles B. Odom, MC
Ninth	Lt. Col. Gordon K. Smith, MC
Fifteenth	Col. William F. MacFee, MC
	In North Africa and the Mediterranean
Fifth	Col. Howard E. Snyder, MC
	In both Europe and the Mediterranean
Seventh	Col. Frank B. Berry, MC
	In the Pacific
Sixth	Lt. Col. Frank Glenn, MC
Eighth	Col. Frank J. McGowan, MC
Tenth	Col. George G. Finney, MC

The importance of the mission which these men performed can best be expressed in terms of lives saved and the decreased morbidity among the wounded. They were vigilant as to the fundamental principles of wound management in the care of battle casualties, they were skillful in the assignment and allocation of personnel under their control, and they contributed immensely to the promotion and maintenance of the high quality of surgical care which was afforded throughout the armies.

Staffs for Various Army Hospitals

A personnel problem which was faced throughout the war was that of the assignment of suitably qualified individuals to key positions in the various Army hospitals in the Zone of Interior and in the communications zones of theaters of operations. The surgical Consultants Division took an active and zealous interest in the selection and recommendation of medical officers as the hospitals were being organized. It was especially concerned with the assignment of specialists in the several fields of surgery. After numbered hospitals

left the United States, the Surgical Consultants Division had no further jurisdiction over their surgical personnel, but, in the case of Zone of Interior hospitals, this did not obtain. The surgical staffs of the latter were frequently being changed as a result of losses to oversea assignments and promotions to positions of greater importance, and also for various unpredictable reasons. Thus, it was constantly necessary for the Division to find suitable replacements and to recommend their assignment. The service command consultants were of inestimable assistance in this regard and were frequently consulted in an effort to keep the key positions in Army hospitals filled with the best men available. The Division was instrumental in defining what was meant by key positions and in establishing the proper number of suitably trained officers to be assigned to them. In this connection, a member of the Division sat on the Kenner Board, a board to study many of the overall problems of medical personnel staffing in the Army, and suggested revision of the surgical service in existing tables of organization for all types of Zone of Interior and communications zones of theaters of operations hospitals. Likewise, it contributed a large share to the formulation of new and revised manning tables for the existing tables of organization. This task assumed greater importance as the war went on with more hospitals being formed and with fewer surgical personnel being available with which to staff them. The manning tables became much more realistic under these conditions and, as revised, eliminated any criticism of overstaffing.

Extensive surveys were made from time to time concerning the qualifications of medical officers assigned to key positions in general, regional, and station hospitals in the service commands. As a result, excesses and deficiencies in surgical specialists were discovered, and suitable adjustments were made. In 1945, a considerable number of medical officers were transferred from the Army Air Forces to the Army Service Forces. The Surgical Consultants Division reviewed their professional qualifications, rated them for assignment in keeping with their professional qualifications, rated them for assignment in keeping with their abilities, and recommended them for proper assignment.

As a result of the intimate knowledge of the qualifications of the surgical personnel in the hospitals in the Zone of Interior, the Surgical Consultants Division was able to effect an equal distribution of surgical specialists throughout these installations, and such officers were assigned in positions where their talents were utilized most effectively. In this connection the following facts, taken from an editorial prepared by General Rankin, chief consultant in surgery, and published in the April 1945 issue of *Surgery, Gynecology and Obstetrics*, are of interest. The assignments of 922 surgical specialists, qualified by their respective boards, were reviewed. Ninety-six percent of these men were found to be properly assigned. Of the 922, there were only 37 who were not actively engaged in performing surgical operations, but each of the latter was serving as a consultant either in the Office of The Surgeon General or in the service commands.

EQUIPMENT AND SUPPLIES

Among the functions of the Surgical Consultants Division, as outlined in various directives, was that of consultation in the matter of equipment and supplies designated for all the component parts of the Medical Department. Immediately upon its creation as a part of the Professional Service, the Surgery Branch began in 1942 an intensive investigation and examination of those surgical instruments, devices, sutures, and other materials which were currently being furnished throughout the entire Medical Department with a view to eliminating obsolete or unnecessary equipment, substituting and adding more modern items, and conserving critical materials. This necessitated a detailed review of all surgical items on existing supply lists, numerous conferences with the Procurement Advisory Division and the Supply Branch, and interviews with many manufacturers and designers of surgical instruments and materials.

At the beginning of the war, surgical instruments were supplied to medical installations as kits, each containing certain items of equipment. Thus, a general hospital, for example, would automatically be issued 12 number X kits; a station hospital of a certain number of beds, 6 kits; and smaller installations, 3 kits. This procedure resulted in a tremendous waste of equipment, for in a general hospital instrument case of 12 kits there would be 12 rib spreaders, 12 kidney pedicle clamps, and 12 of each of many other items of which only 1 or 2 were actually required. Also there would be too few of such essential instruments as hemostats, curved clamps, scissors, et cetera. In addition, there were many instruments, considered to be essential by civilian surgeons, which were not on the lists at all. By far the major portion of the task of resolving these supply problems was completed during the first 9 months of the war, but during the remainder of the conflict the continuous examination and reevaluation of surgical items of equipment constituted an important portion of the work of the Division. As new methods of treatment and hitherto unknown therapeutic agents were developed, the responsibility for evaluating them and determining how they were to be tested, used, and allocated to the various Army installations was that of the Surgical Consultants Division.

Revision of Supply and Equipment Lists

In the attempt to revise the lists of basic specialty instruments, certain difficulties were encountered and were concerned primarily with manufacturing details. This was due to the fact that a large number of these precision instruments had always been imported and, when this supply had terminated at the onset of the war, it became necessary for the manufacturers in this country to establish their own tooling process and to train personnel in this specialized craft. Accordingly, in revising the lists of basic and specialty instruments, this was kept in mind since it was necessary to conform to the ability of manufacturers to obtain requisite materials and to meet the supply requirements in an expeditious fashion. Great credit is due the manufacturers for their ability

to overcome these obstacles and to supply quickly equipment of standards equal to, or even higher than, the standards of that formerly available.

It would be difficult to name all the results and advantages of these activities. Some of the more important of these included a complete revision of lists of suture materials and needles. In suture materials alone, considerable economy was effected by the deletion of large quantities of expensive catgut and the substitution of cotton and silk thread which was not only much less costly but actually better suture material. Similarly, certain types of suture needles, the use of which did not predispose to good surgery, were taken off the lists entirely and proper ones substituted. In addition to such changes, recommendations were made for the deletion of numerous surgical instruments and articles which were no longer in common use and for the addition of more recent equipment necessary for the performance of the most modern surgical procedures. Examples of the latter were the addition of needles suitable for performing sympathetic block to relieve vasospasm associated with injuries of the upper and lower extremities, physical therapy equipment for various-sized hospitals, X-ray equipment and foreign-body locators, and adequate apparatus for gastroduodenal suction. The contents of several types of medical chests and first aid kits were revised.

Other results obtained which were worthy of special mention were recommendations for the complete surgical equipment for a surgical operating truck and for the portable hospitals. Equipment lists of surgical items for the evacuation hospitals and the 500-bed general hospital were reevaluated and revised. Suggestions for the addition of specialized instruments for the special surgical centers were also made. Thus, for the neurosurgical and vascular centers, special items, such as electrical cutaneous apparatus, oscillometers and thermocouples, were provided. The entire list of anesthetics on the supply catalog was reviewed with the purpose of determining their adaptability to an overall Army policy concerning such agents based on simplicity, safety, and anesthetic efficiency. On the basis of this review, the number of anesthetic agents was reduced from 19 to 12, and War Department Technical Bulletin (TB MED) 43, Local Anesthetic Agent, was published on 18 May 1944. Recommendations were made concerning the procurement and preparation of cotton waste and petrolatum-impregnated gauze for the care of burns, and these items were added to the supply catalog. The Division also aided in the preparation of the list of supplies for civilian aid in occupied countries and for Americans who were held prisoners of war by the enemy.

Central Supply Service in Hospitals

As a means of conserving certain medical supplies and of extending their period of usefulness, the Surgical Consultants Division in February 1943 proposed the establishment of a central service system adaptable for utilization in various station and general hospitals. This system consisted essentially of a

centralized agency where equipment which was used for certain diagnostic and therapeutic procedures, particularly in preoperative and postoperative care, was to be prepared and dispensed. Among these items were those employed in the performance of transfusions and intravenous medication, wound dressings, spinal puncture, thoracentesis, catheterization, gastric lavage, and oxygen administration. These pieces of equipment were of the sort that might be used for any patient but only as the occasion demanded. Their constant presence on each ward was obviously unnecessary and, consequently, entailed expenditures for unreasonably large quantities of supplies. It was apparent, therefore, that the institution of a centralized agency responsible for the maintenance, proper preparation, and dispensation of these supplies not only would permit greater utilization from a smaller total quantity of supplies but also would mean greater care, longer life, and a readier responsibility for many critical supplies. Likewise, a considerable saving could be made by the more effective utilization of personnel. The proposal of this system was considered particularly important in view of the tremendous burden imposed on the medical supply facilities by the rapidly expanding Army. This burden was being increased steadily by the fact that the availability and production of many articles were becoming critically limited.

The recommendation by the Surgical Consultants Division that the centralized type of agency be established in both general and station hospitals met with the instant and unanimous approval of all concerned in the Professional Service, but it took a great deal of time to convince the Supply Division that the plan was a good one. A whole year elapsed before the plan was finally approved by all concerned, and War Department Memorandum No. W–40–44, Central Service System in Army Hospitals, was published on 12 April 1944, authorizing the establishment of this system which functioned with eminent success throughout the remainder of the war.

Penicillin

Early in 1943, the new antibiotic, penicillin, was attracting attention on account of its highly promising therapeutic possibilities as revealed by preliminary clinical and laboratory observations made both in England and in the United States. The enormous potential value of this drug in military surgery was quickly realized by the Surgical Consultants Division. There were many conditions which, if they responded to this agent as accurately as seemed indicated, were of frequent occurrence among military personnel and constituted serious problems from the standpoint of decrease in manpower, increase in hospitalization, and the imposition of added burdens on medical personnel and medical facilities. It was evident that the therapeutic possibilities of penicillin should be quickly and effectively explored. The limited productibility of penicillin at that time greatly restricted its clinical and experimental use. The manufacture of the drug was a slow and laborious process as well as a very ex-

pensive one, the drug was in great demand by the civilian population, and there was very little to be had by anyone. It was obvious that, if the Army was to evaluate properly this therapeutic agent, it needed the lion's share of the available material and had to proceed promptly with a thorough clinical trial of this new drug.

It was for these reasons and in order to ascertain more exactly the usefulness of this agent, to determine its indications and contraindications, and to standardize the therapeutic procedures associated with its use, that the Surgical Consultants Division, with the cooperation of the Committee on Medical Research of the Office of Scientific Research and Development, established a program to conduct intensive investigative studies on wound infections and sepsis in a limited number of general hospitals in this country. The first unit in this program was Bushnell General Hospital at Brigham City, Utah, and it began to function on 1 April 1943. A second unit was established at Halloran General Hospital, Staten Island, N.Y., on 3 June 1943. For the first few months, these institutions were centers for clinical and some experimental work with the drug. Emphasis was placed on the type of case which was suitable for treatment, on the most effective dosage, on the route of administration, on the length of treatment, et cetera. As soon as these had been determined with reasonable accuracy, the two centers were used as schools in penicillin therapy for medical officers from other army hospitals which were later to be engaged in this program of evaluating penicillin. As more and more such officers were trained and as more and more of the drug became available, additional general and station hospitals were placed in the program.

In order to assure a certain degree of standardization and homogeneity in the overall study, each of the officers trained in penicillin therapy in each hospital was charged with the full responsibility of determining the cases to be treated and the details and procedure in their treatment, of acquiring necessary laboratory studies, and of maintaining and forwarding to the Surgical Consultants Division in the Office of the Surgeon General all of the case records. The Division analyzed all such reports, tabulated them, and made an accurate evaluation of them. In this way, an immense amount of quite accurate information was quickly obtained with the least waste of a scarce product. This information was rapidly disseminated to all medical officers throughout the Army by the Office of the Surgeon General and to civilian physicians by papers published in the *Journal of the American Medical Association* or by addresses given before several medical and surgical societies. For example, an article was published in the 18 December 1943 issue of the *Journal of the American Medical Association* by Maj. Champ Lyons, MC, who was in charge of the studies at Halloran General Hospital, dealing with 209 cases treated with penicillin. Major DeBakey of the Surgical Consultants Division participated in a panel discussion devoted to penicillin at a meeting of the American Medical Association in June 1944 and reported on the use of penicillin in the treat-

ment of over 1,500 cases of surgical infections of various kinds including 74 cases of septicemia, 169 cases of infection of the skin and subcutaneous tissue, 152 cases of wound infection, 62 cases of abscess, 78 cases of gas gangrene, 138 cases of septic compound fractures, and 265 cases of osteomyelitis. Colonel Carter gave a similar presentation to the Kentucky State Medical Association on 19 September 1944. Members of the Division prepared numerous articles on penicillin for the *Bulletin of the Army Medical Department*, as well as several circular letters and a technical bulletin on the subject. The Surgical Consultants Division endeavored to maintain and advocate an open mind concerning the effectiveness of this drug and prevented the publication of many papers by medical officers which would tend to indicate that penicillin was a panacea in the treatment of all surgical diseases.

Until adequate amounts of penicillin were made available to all medical installations throughout the entire Army by the remarkable ingenuity of the manufacturers, it was necessary to allocate the drug to those installations, both in the Zone of Interior and in the theaters of operations, in which it could be utilized most effectively. For this purpose, a penicillin board was set up in the Office of the Surgeon General. The board met at weekly intervals and did much to insure the proper distribution of the drug. A member of the Surgical Consultants Division sat on this board and, with the background of the information obtained as noted above, was able to contribute greatly to the effective functioning of his body. It can be safely said that both the investigative study sponsored and controlled by the Surgical Consultants Division and the Division's effort concerning the proper distribution of penicillin played a most important part in furthering the proper and prompt usage of this very valuable drug.

PUBLIC RELATIONS AND LIAISON

Throughout the war, the Surgical Consultants Division consistently endeavored to maintain close rapport and liaison with various institutions and organizations including the National Research Council, medical schools, civilian surgeons, and surgical and medical societies. It was believed that a closer cooperation with and support to the Office of the Surgeon General would be afforded by these important organizations if such a relationship was established. This purpose was greatly facilitated by the fact that the chief surgical consultant, General Rankin, was president of the American Medical Association, vice chairman of the American Board of Surgery, and president of the Interstate Post-Graduate Assembly. In addition, other members of the staff of the Division were active and well-known members of various surgical organizations. Considerable effort was expended by the Division in this direction from the beginning to the end of the war. Some of the more important contributions of the Division toward the establishment of this important relationship are given in the following paragraphs.

During April, May, and June of 1942, the American College of Surgeons conducted a series of war sessions in representative cities throughout the country. These sessions were attended by thousands of surgeons, and in each of them a member of the Division participated importantly. He outlined the organization of the Medical Department which had been set up for the care of battle casualties, discussed many of the surgical problems of military significance, and presented the current methods used by the Army in the management of wounds, burns, shock, and fractures.

At the second series of war sessions held in 1943, a paper entitled "The Care of the Injured in the Combat Zone" was prepared by members of the Division and was presented by various medical officers. This paper received such favorable comment that it was published in the bulletin of the College. Again in 1944, another series of war sessions was held. At this series, a paper entitled "War Wounds of the Extremities" was read by designated Medical Corps officers at the various meetings. The paper was prepared by members of the Division. At these sessions, a film was also shown which had been especially prepared by medical officers in the Division. The film was entitled "Evacuation and Care of Battle Casualties." This motion picture was so popular that it was necessary to show it several times during each meeting, rather than only once as had been originally planned. These sessions proved to be eminently successful in disseminating the existing knowledge which had been acquired in the care of the sick and wounded. They stimulated the interest of the civilian surgeons in the Medical Department and did a good deal to promote their seeking commissions as Medical Corps officers.

At frequent intervals during the war years, the Division prepared papers for presentation by its members, by The Surgeon General, and by various members of the Office of the Surgeon General at formal and informal gatherings, surgical society meetings, and lay meetings. Such papers dealt with the current and future activities and the personnel requirements of the Medical Department of the Army, considerations of military surgical problems, detail of the care of various types of war wounds, reviews of the accomplishments and contributions of the medical profession during the war, rehabilitation of the wounded, amputations, the use of plasma and whole blood, and similar subjects. Many other papers were prepared for delivery at dedication ceremonies, manufacturing meetings, commencement exercises, and radio programs. Approximately 175 of these papers were prepared. Presentations of strictly surgical subjects were made at meetings of the leading surgical societies such as the American Surgical Association, the American College of Surgeons, the Southern Surgical Association, the American Association for Thoracic Surgery, the American Medical Association, the American Academy of Orthopedic Surgeons, and the American Orthopedic Association. Not only did these papers serve as a valuable public relations function but they contributed importantly to the surgical literature, and most of them can be found in the national surgical journals of that period. Addresses were given by members of the Division. Still others

were prepared for delivery by The Surgeon General at meetings of the Southern Medical Society, service command hospital gatherings, meetings of the editors of State medical journals, the Council on Medical Education, the trustees of the American Medical Association and the House of Delegates of that association, and several State medical societies. The Surgeon General also spoke at dedication ceremonies of numerous military and civilian hospitals and memorial buildings and at presentations of a considerable number of "E" awards to industrial plants. These addresses did much to keep a wide segment of the population informed concerning the accomplishments of the Army in the surgical care of the sick and wounded.

Every effort was made to maintain a close liaison with the National Research Council. Members of the Division were in frequent attendance at appropriate committee meetings of the Council including those of the Surgical Committee and the subcommittees on faciomaxillary injuries, blood substitutes, orthopedic surgery, ophthalmology, burns, gas casualties, and surgical infections. Problems which confronted the Medical Department of the Army were presented before these committees for investigation and solution, while, on the other hand, recent developments, advances, and innovations which had resulted from research activities and investigative studies of the National Research Council were given to the Army for evaluation and for possible use. The assistance which the Council rendered the Armed Forces was invaluable, and great credit is due it for its unfailing cooperation and devoted service. Without its help, many problems would have remained unsolved, many lives would have been lost, and much valuable information would have been long delayed in reaching the military forces.

It would not be feasible in this volume to give a detailed account of the many surgical problems which were considered at the Council meetings or of their solution or rejection. Some of the more important ones were the evaluation of the use of the sulfonamides in surgical infections, the preparation and preservation of plasma, the viability of the red blood cell, the use of serum albumin, the methods of prolonging the safe use of whole blood, the design for a suitable container for oversea shipments of whole blood, the evaluation of the usefulness of penicillin, the proper management of burns, the development of a toxoid for gas gangrene, foreign body locators, tantalum wire and film, and nerve suturing. A most kindly and cooperative relationship existed between the Council and the Surgical Consultants Division. At times, however, when the Army rejected a Council proposal as an impractical measure or as a plan which could not be adapted to its complex organization and varied personnel, the atmosphere would become a bit strained. But such incidents were rare, and the meetings of the Council committees were enjoyable and most profitable. Numerous advances and developments in many fields of surgery were evolved and were promulgated in Army medical practice through this valuable reciprocal relationship between the Army and the Council.

REVIEW OF MANUSCRIPTS AND LITERATURE

All articles written by officers of the Medical Department were required to be submitted to the Office of the Surgeon General for approval before publication. This was in accordance with paragraph 8, section III, Circular Letter No. 1, Office of the Surgeon General, dated 1 January 1943, with Circular Letter No. 192, Office of the Surgeon General, dated 20 November 1943, and with Army Regulations No. 310–10, dated 27 February 1943. It was required that all articles which dealt with surgical subjects be reviewed by the Surgical Consultants Division, that their suitability for publication be determined, and that, if approved, further clearance be obtained from the Bureau of Public Relations, War Department. One of the time-consuming functions of the Division was the review of all these manuscripts on surgical subjects which were submitted by medical officers as well as those by civilian newspaper and magazine correspondents reporting on the activities of the Medical Department. A conscientious effort was made to review such articles and to present constructive criticism to the authors. In general, the manuscripts were classified into three groups; namely, those which were approved for publication elsewhere than in the *Bulletin of the U.S. Army Medical Department*, those approved for publication in the *Bulletin*, and those disapproved. In the latter category, the Office of Technical Information returned the paper to the author with a letter outlining the criticisms of the Office of the Surgeon General and the reasons for disapproval. The paper could be rewritten, if desired, in accordance with this letter and resubmitted. Many such instances occurred.

These articles were reviewed according to certain criteria; that is, that the contents did not reveal information of value to the enemy, did not break the rules of medical ethics, did not show serious literary or scientific errors, did not contain malicious, foolish or frivolous matter, did not purport, without the proper authority, to represent the official attitude of the Army or the Medical Department, and did not harmfully criticize an agency of the Government or those of our Allies. The vast majority of these articles, if approved, were transmitted directly to that journal in which the author had requested its publication. The importance of this review function was far greater than might at first be realized. A certain number of the papers which were prepared by medical officers were poorly written and often filled with inconsistencies. It was therefore of considerable importance that they be reviewed for professional content and that appropriate recommendation be made to the authors as to the suitability of the articles for publication. Since the approval of the Surgical Consultants Division had to be obtained before publication could be considered, most medical officers were stimulated to prepare their manuscripts more carefully. In addition, since the authors knew that any article published had to be approved by the Division, it was considered that its publication was tantamount to endorsement by the Office of the Surgeon General of the therapeutic methods described. In view of these facts, the Division was extremely cautious in the

selection of material for approval. It was obviously impossible to approve papers which were in conflict with stated policies of the Office of the Surgeon General. In a few instances, papers contained observations which in civil practice would deserve publication but which were disapproved by the Division because of the interpretation in terms of Medical Department policy which other medical officers would attach to publication.

An example of such a possibility was a paper received by the Division regarding the successful control of ether convulsions by curare. This case report was of interest and would have been approved for publication had it not been for the fact that curare was known to be a dangerous drug and one about which most medical officers knew very little. Furthermore, it was not a standard item of supply. Had the paper been published, there was little doubt that in the light of past experience, this office would have received numerous requisitions for this agent for use in similar related conditions. It is obvious that the widespread use of such a drug as curare by men incompletely informed as to its pharmacological actions would have been highly undesirable.

Papers which appeared to be particularly suitable for publication in the *Bulletin of the U.S. Army Medical Department* were so recommended, and the author usually agreed to that procedure. In the case of particularly important papers for which the authors requested publication in specific journals (such as *Surgery, Gynecology and Obstetrics; Annals of Surgery;* or the *Journal of the American Medical Association*), no insistence was made that such material be published in the *Bulletin.* However, abstracts of such articles were frequently prepared for that publication, and in some instances an entire article was reprinted.

The number of articles submitted for review by the Division increased steadily each year of the war. For example, in the month of January 1942 there were 39; in January 1943, 119; and in April 1943, 163. The average number of articles received each year for review was approximately 850. The usual percentage of rejection was about 23. In addition to these articles, the Division was called upon to review innumerable surgical textbooks and similar publications on surgical subjects to determine their suitability for use by the Medical Department of the Army.

EDUCATION AND TRAINING

It quickly became apparent to the Surgical Consultants Division that it should emphasize and be concerned importantly with education and with training. In order to accomplish these functions, it was necessary to work closely with the Plans and Training Division and with the Army Medical Museum in an active initiating capacity as well as in an advisory one. Not only was the preparation of instructional aids and literature on various surgical subjects an important function of the Surgical Consultants Division, but in addition it was imperative that the Division provide the proper media through which such material could be disseminated effectively throughout the Army.

Publications

At the beginning of the war, the National Research Council undertook the task of preparing various war manuals dealing with those medical and surgical conditions which were important from a military viewpoint. The Surgical Consultants Division, with the information it had acquired from reports from surgical consultants in the United States and abroad, from personal contacts, and from bulletins received from theaters of operations, was in a position to offer considerable assistance and guidance in the preparation of those manuals dealing with surgical subjects. For example, the war manual on abdominal injuries was largely prepared by the Surgical Consultants Division and was revised from time to time to include new material, such as compression injuries occurring in individuals who were partially submerged in water in the region of depth charge or torpedo explosions. The manual on transfusion therapy was critically reviewed, and suggestions were made for its revision. The Division collaborated in the preparation and critical evaluation of all other manuals concerned with surgical subjects. In an effort to make available to medical officers the best current surgical opinion on war injuries, copies of the war issues of the *Bulletin of the American College of Surgeons*, which contained the most modern account of the management of war injuries, were acquired, apportioned, and distributed to all general and station hospitals both in the continental United States and abroad.

During the first year of the war, Technical Manual 8–210, Guides to Therapy For Medical Officers, was critically reviewed, and recommendations for changes and additions of new material were made. A new Field Manual 21–11, First Aid for Soldiers, was written by the Division during this same period in cooperation with the Medical Consultants Division. A great deal of time was spent in the preparation of this manual. There were numerous conferences with artists and photographers at Carlisle Barracks, Pa., and with representatives of the Quartermaster Corps who had arctic experience concerning equipment, supplies, and procedures as related to first aid for the sick and wounded in extreme cold and snow.

In the early part of 1943, the preparation of a new book, "Surgical Anatomy for Medical Department Personnel," was begun, since the existing one had become difficult to obtain and was in need of simplification and revision. Many hours were spent in conference with Mr. Tom Jones, the medical artist who was engaged in editing this volume, regarding the types of illustration, methods of presentation of material, and the material to be included. Several months later, the volume appeared and was most enthusiastically received. In addition to the large size for libraries, a pocket-size volume was published for medical officers. The Surgical Consultants Division took a large share of the credit for this book, which furnished to Medical Department personnel a compact, simple, and beautifully illustrated surgical anatomy.

Visual Aids

A close liaison was maintained throughout the war with Col. James E. Ash, MC, and his staff at the Army Medical Museum in an effort to make available various types of material for the education and training of Army personnel. Among the results of this cooperative association and effort were the moulage models of war wounds, which depicted so graphically the anatomy and the pathology of these injuries; the collections of lantern slides depicting a wide range of surgical conditions, operations, methods of evacuation, and other subjects; and a library of motion pictures portraying the many phases of the surgical activities of the Medical Department. The collection of lantern slides which was inaugurated by the Surgical Consultants Division was unusually complete. This resulted from the fact that, at regular intervals, a member of the Division reviewed the great volume of photographs which poured into the Army Medical Museum and selected material which was suitable for inclusion in the collection. This collection proved invaluable as a source of illustrations for lectures, training programs, and history.

Motion pictures were considered to afford the most effective medium for training, orientation, and teaching. Accordingly, the Division took a special interest in them. It was active in the selection of pertinent subjects for portrayal by this means, in the collection of film from overseas and in this country, in the integration of material into a complete motion picture, and finally in the actual production of the finished product. Innumerable obstacles were overcome in this field of endeavor, the chief of which was the difficulty in getting the Signal Corps of the Army to process film, to splice it, and to furnish sound tracks and titles. It was actually necessary in the beginning of the motion picture program to have the work done in commercial studios or to seek the aid of the U.S. Naval Photographic Science Laboratory in Washington. The latter institution was extremely cooperative, and much credit is due it for its prompt, willing, and excellent assistance. Various members of the Division literally nursed these motion pictures along and were solely responsible for their production. After the value of these pictures was appreciated, their production through the Signal Corps became much easier. In order to insure the acquisition of well-prepared motion pictures on important clinical problems relating to military surgical conditions, it was considered desirable that the Office of the Surgeon General obtain the services of an experienced clinical photographer, who could be sent to various medical installations for the preparation of such films. Mr. Milton Trauber of New York City was appointed consultant in graphic surgical technique in March 1945. His choice was an excellent one, and under his direction many thousand feet of film were produced in the general hospitals in the United States. Such films dealt with varied conditions among which were the convalescent care and rehabilitation of spinal cord injuries, the treatment of traumatic osteomye-

litis, repair of peripheral nerve injuries, and operative procedures in the care of penetrating wounds of the chest.

In summary, it can be said that, by its active interest and perseverance, the Surgical Consultants Division was responsible for the collection, the actual preparation, and the filing of a library of still and motion pictures which was of immense value in the orientation, training, and education of Medical Department personnel. The historical value of such a collection is immeasurable.

Medical Bulletin

The Surgical Consultants Division was intensely interested in the subject of dissemination of professional information to medical officers and made numerous attempts to provide suitable media for this purpose. This was considered an important function of the Office of the Surgeon General and essential for the maintenance of the health of the Army. Statistical data, factual knowledge, and various new developments about diseases, injuries, and surgical equipment were being obtained at frequent intervals by the Division from numerous sources. This information was continuously being analyzed, interpreted, condensed, and translated into proper military form and, because of its vital significance, had to be disseminated promptly and regularly and made available to every medical officer. Accordingly, the Division repeatedly urged, during the first years of the war, the adoption of a well-integrated program for disseminating information and the establishment of a suitable medium for such transmission. It was proposed that this medium be distinctive in content as well as in format and that it appear monthly with the period elapsing between the preparation of the material and its publication, not to exceed one month. Accordingly, it was first recommended in June 1943 that the then existing *Army Medical Bulletin* which was published every three months be reconstituted to answer this purpose. This and several similar recommendations were disapproved, but finally such a program was approved, and in October 1943 the first issue of the *Bulletin of the U.S. Army Medical Department*, a monthly publication, appeared. The welcome reception the latter publication received together with the fine comments concerning it fully justified the efforts expended in producing it.

In order that the *Bulletin* might truly represent a valuable source of the latest information on pertinent and timely problems relating to military surgery, the Surgical Consultants Division contributed many articles for publication within its pages during the remainder of the war. It was the opinion of the Division that succinct statements of important fundamentals of military surgery repeatedly emphasized in the *Bulletin* would constitute a real and effective means of maintaining a high level of surgical care throughout the Army. This publication also afforded a medium through which medical officers in forward echelons could be kept informed of the results which were being obtained by the Medical Department as a whole. The Division contributed 90-odd articles to the *Bulletin* during the war years. A complete list

of these would be out of place here, but it might be stated that among the varied subjects were penicillin, aneurysms, trenchfoot, immersion foot, cyclopropane anesthesia, pilonidal sinus, quadriceps deficiency, wounds of the rectum, blast injuries of the ears, tropical ulcers, morphine poisoning, tourniquets, new gas casualty set, clinical significance of the Rh factor, acute infections of the hand, and parachute surgical teams.

Directives

Other media for the dissemination of information consisted of circular letters from the Office of the Surgeon General, War Department circulars, TB MED's, and command letters of the Army Service Forces. These were distributed through command channels and for this reason did not necessarily reach each medical officer. In fact, many officers stated that they did not receive many of these directives which would have been most helpful to them. The Surgical Consultants Division was active in contributing a great deal of informative material for these directives throughout the war. In the earliest days of the war, the circular letters of The Surgeon General were the most frequently used medium. Again, it would not be feasible at this point to list all such contributions, which were quite numerous and dealt with varied conditions and situations. Approximately 20 circular letters, 15 War Department circulars, 5 Army Service Forces letters, 10 directive letters to service commands, and 20 TB MED's were prepared by the Division from 1942 to the end of the war. The importance of these directives was emphasized by the fact that one of the most urgent functions of the Surgical Consultants Division was the definition of professional policies which governed many aspects of surgical practice throughout the Army. The fact must be emphasized that there was a wide variation in the professional abilities of medical officers. In certain instances the application in the Army of certain surgical procedures, therapeutic measures, or drugs used in civil practice had to be prohibited. This was necessary in order to minimize undesirable results or untoward accidents known to occur when all medical officers were permitted to use the particular procedures, methods, or drugs in question. The directives noted above constituted the means by which professional policies were defined.

Reference has already been made to the effectiveness of the report, Essential Technical Medical Data, as a means of obtaining accurate information concerning the care of the sick and wounded in theaters of operations. This information, when received, could then be transmitted to the other theaters as well as to installations in the Zone of Interior. It became apparent that such data should also be obtained in the same fashion from medical installations in the continental United States, and memorandums requesting this were sent to the proper authorities in the Office of the Surgeon General. These requests were refused. The value of such reports with sections devoted to professional problems encountered and results achieved in Zone of Interior facilities would have been of great value not only to the Office of the Surgeon General but also

to theater surgeons and their consultant staffs. It was difficult to provide a clear concept of therapeutic objectives, as visualized by specialists overseas, to medical officers in the United States. Similarly, the problems confronting specialists in the Zone of Interior and the results achieved in cases which received initial care overseas were unknown to medical officers in theaters of operations. It is earnestly recommended that, in future conflicts, reports similar to the Essential Technical Medical Data report be required from both theaters of operations and Zone of Interior commands.

On-the-Job Specialty Training

Owing to the shortage of surgical specialists, including anesthesiologists, training schools were instituted at certain designated medical schools throughout the country in the first year of the war. The courses given were for a 3-month period. The selection of individuals to take these courses was the responsibility of the Training and Military Personnel Divisions in the Office of the Surgeon General. The Surgical Consultants Division never endorsed these courses and, in fact, was generally opposed to such a method of attempting to train a surgical specialist at a medical school by lectures and demonstrations in so short a time. Many of these courses proved fruitless. As the war went on and the load of work increased in the general hospitals in the United States, the Surgical Consultants Division suggested that medical officers with the proper background be sent to these installations and assigned to specialist services for on-the-job training. Since the number of such officers in any one institution was small and since they could be supervised by certain of the Army's outstanding specialists, the results were very satisfactory, and a considerable number of men were trained in this way. This was especially true in the case of neurosurgery and in anesthesia. In the latter category, there was an unusual shortage of trained personnel, so that nurses were trained in anesthesia in the Zone of Interior by the above method. This did much to release physician anesthesiologists for oversea duty. In line with this policy of on-the-job training, the Division successfully recommended that, rather than give refresher courses to those medical officers returning from extended tours of duty in nonprofessional assignments or in assignments which had afforded limited surgical practice, these officers be assigned as ward officers or assistants in general or large station hospitals in the Zone of Interior in their specialty. Many officers were thus assigned and were able once more to take up an active practice in the specialty in which they had been interested.

In cooperation with the Medical Advisory Board, the Surgical Consultants Division established a program by which it would be possible to provide medical officers who were candidates for certification by specialty boards to obtain credits for training and experience in the respective specialties acquired during military service. A Medical Officers Service Record was prepared which, when properly completed, would provide authentic data for the various

committees on eligibility of the American Specialty Boards for evaluation of the experience which had been acquired by the medical officers.

CONSULTATION

It is evident from the preceding pages that the majority of the activities of the Surgical Consultants Division were in reality of a consultative nature. Mention has been made of the efforts to procure and disseminate surgical information to medical officers, to guard against certain surgical practices which were not considered proper, to supply adequate amounts of drugs and equipment, to train and educate Medical Department personnel, and to assign surgical personnel in the most effective manner. However, little has been said thus far concerning the paramount function of the Division in strictly professional consultation as related to the surgical management of the sick and wounded. Since the staff of the Division was never engaged in the actual surgical care of such individuals during the war, its consultative contributions to clinical surgery in the Army stemmed of necessity from each staff member's own background of surgical training and experience, from his knowledge of sound surgical principles, and from his ability to evaluate the mass of surgical data which was being received constantly by the Division. Thus, it was necessary for the Division staff to analyze the multitude of reports which were received from many sources throughout the Army, to evaluate their contents in an effort to determine those surgical conditions which were assuming importance as the war progressed, and to make certain that such conditions were being managed in accordance with the most effective methods. Also, it was the responsibility of the staff to ferret out and to prohibit surgical practices which experience had shown to be dangerous or outmoded, as well as to recognize and make mandatory by directives those practices which had been proved to be most satisfactory. As has been stated previously, The Surgeon General had complete authority in the Zone of Interior, and there the enforcement of directives was readily accomplished. The service command consultants were invaluable in disseminating the information gained by the Division and in enforcing those policies recommended. The visits of members of the Division to service commands were also very effective in this regard.

Reference has been made to the role which the Division played in the early recognition of the military potentialities of penicillin and in its prompt evaluation and proper use. Similar reference has been made to the use of plasma and whole blood. In addition, there were a number of other instances in which the Division was alert to the clinical application of laboratory investigations, the importance of certain surgical conditions from a military viewpoint, and the necessity of advocating measures for their proper management. Several of these will be commented upon, but, since they have been dealt with in detail in volumes of the history of the Medical Department, United States Army, in World War II which are concerned with surgery, they will be described very briefly here.

Trenchfoot

Perhaps the most unsatisfactory experience of the war was that concerned with trenchfoot.[2] The entire story of this condition was a sad one particularly in view of the fact that the condition was preventable and in view of the fact that the Surgical Consultants Division early in 1943, as a result of the experience on Attu, directed attention to the need for anticipating its widespread occurrence. The complete story may be obtained from a section of the 1945 fiscal year report of the Division prepared by Colonel DeBakey. Colonel DeBakey was intensely interested in this condition from the time of the receipt of the first reports in 1943 concerning its occurrence. He warned against the seriousness of this disease from a military point of view and pointed out the measures by which it could be prevented or, if already contracted, how it should be treated. There was an impenetrable indifference to his warnings and suggestions until the condition became one of major military importance as a result of the terrific loss of manpower which it caused among combat troops. Colonel DeBakey's account follows.

In the 1943–44 annual report of the Surgical Consultants Division, it was stated that the high incidence of trench foot among troops in Italy during the winter of 1943–44 represented "perhaps the most unsatisfactory experience of the war." It was further stated that "it is hoped that the measures now being instituted will prevent a recurrence of this unsatisfactory experience." Unfortunately, this hope was not realized. During the winter of 1944–45 in Western Europe the problem of trench foot assumed alarming proportions, exceeding by far in severity the situation in Italy during the previous winter. In fact, no military force in the field with the possible exception of Napoleon's armies in the War of 1812 has ever experienced such a devastatingly high incidence of cold injuries.

In view of these facts it is considered of interest and in order for this year's annual report to review the role which this division played in the trench foot problem. It is neither the purpose nor intent of this report to point an accusing finger at any other branch, division, service or corps as being responsible for this tragic experience. The main objective is to record as faithfully and as accurately as possible the activities of this division for the consideration of any who in the future may be interested in them. With this purpose in mind the following remarks are presented:

Between 11 May 1943 and 11 June 1943 there were 3,829 hospital admissions on Attu, 1,200 of which were listed as disease resulting from "exposure." Due significance was attached to this observation by a number of divisions in the Office of the Surgeon General, among which was the Surgical Consultants Division. The immediate implications of this experience in terms of future operations in Europe were more acutely appreciated by those who were informed on the experiences with cold injuries among military forces of previous wars. On 29 July 1943 a meeting was held in the Research Coordination Branch on the Effects of Cold, and certain principles of first aid or emergency treatment were adopted and preventive measures discussed. A memorandum prepared by the Research Coordination Branch of the Operations Service for The Surgeon General and concurred in by the representatives of interested divisions presented a resume of the discussions and recommendations of this group. The Surgical Consultants Division began to devote considerable attention to this problem which, although of negligible importance as far as the Army's experiences at that time would indicate, was appreciated as a condition which could become

[2] For the history of trenchfoot in World War II, see "Medical Department, United States Army, Cold Injury, Ground Type Washington U S Government Printing Office, 1958."

one of tremendous significance in the inevitable future large scale operations in Europe. On 23 August 1943 this division prepared a memorandum on "Revision in accordance with modern concepts of military publications on the subject of injuries resulting from cold" for Brigadier General C. C. Hillman, who was Chief of the then existent Professional Service of the OTSG. The last two paragraphs of this memorandum read as follows:

"3. No reference is made to the conditions of 'immersion foot,' 'trench foot' and 'shelter feet' in any of the Field or Technical Manuals except FM 21–11, First Aid for Soldiers. In view of the importance of these conditions and their disabling effects it would seem desirable to disseminate, especially through the medium of manuals, information concerning their prevention and treatment.

"4. It is, therefore, recommended that these subjects be brought to the attention of appropriate agencies of The Surgeon General's Office for correction. This Surgery Division is prepared to cooperate in the publication of this material."

Besides conducting a review of the literature on the subject of cold injuries, which included the related conditions of trench foot, immersion foot, frostbite, and high altitude frostbite, this division carried on extensive correspondence with Colonel Luther Moore of the Alaska Defense Command regarding all phases of cold injuries in that command. Likewise the Office of the Base Surgeon, Greenland, was contacted and information obtained on the status of cold injuries as a problem in that region. Furthermore, conferences on this subject were conducted by the National Research Council and attended by a representative of this division.

On the basis of the material which had been compiled by the Surgical Consultants Division another memorandum dated 15 October 1943 was prepared for the Chief Professional Service the subject of which was "Frostbite, Immersion Foot, and Related Disorders." This memorandum recited the activities of this office up to that time and directed attention to two articles which had been prepared for publication in the *BULLETIN OF THE U.S. ARMY MEDICAL DEPARTMENT*, one entitled "Immersion Foot" and the other, "Frostbite." The first two paragraphs of this memorandum are quoted here to reveal the status of the Army's experience at the early date and the attitude which this division assumed in regard to the importance of training and proper equipment as effective preventive measures:

"1. Because of the potential significance and jeopardous effect upon military operations in certain regions, injuries resulting from exposure to cold, such as frostbite, trench foot and immersion foot have received serious consideration by this office. Accordingly, an effort was made to determine the current incidence and morbidity of those hazards of exposure to cold and to survey the present scope of the problem as well as the recent authoritative knowledge on the subject with the view of ascertaining the need for further study and preparing, coordinating, and disseminating the best information on prophylaxis and therapeutics of these conditions.

"2. In an effort to determine the incidence and morbidity of this subject, the reports from the various regions where military operations are conducted at very low temperatures were reviewed and a letter was forwarded to Colonel Moore requesting information on the frequency and seriousness of these conditions in Alaska. A copy of this letter is inclosed. The results of this review revealed that the incidence of these conditions is relatively low. A report from Northwest Service Command, Essential Technical Medical Data, for August 1943, states that "Frostbite of the extremities in a mild form has been fairly common; however, serious cases requiring amputation have numbered less than six for this entire period in the whole command which at one time included 22,000 troops. The best method of prophylaxis has been education, discipline and use of proper equipment for cold weather.' Another report for August 1943, from the Office of the Base Surgeon, Greenland, states "the incidence of frostbite has been practically nil due to the excellency of clothing and instructions by the Base Surgeon to all personnel on how to early recognize and prevent frostbite. A very few mild cases of immersion foot have been seen. Palliative measures only were

used in treatments and the total number of cases were too small for any statistical evaluation on methods of procedure." Another report for June 4, 1943, from Ft. Richardson, Alaska, states that there were 43 cases of immersion foot among casualties evacuated from Attu Island. These were all improving rapidly under a conservative treatment and required no additional measures. Another report from Hams, Alaska, on March 31, 1943, concerning the number of casualties from frostbite incurred during a maneuver in which 535 men participated states that approximately 8% required hospitalization. More recently a survey of the cases evacuated from Attu Island to Zone of Interior with immersion foot and frostbite, only about four or five per cent required hospitalization longer than several weeks and only a very few of these required amputations of parts of the extremities. A great majority of these recovered completely under conservative measures and were returned to full duty status. It will also be observed in Colonel Moore's recent letter, 13 September 1943, a copy of which is attached, that the incidence of frostbite and immersion foot among personnel in Alaska has not been very high and the cases are so mild that very few have had serious consequences. According to this review on the incidence and morbidity of these conditions it would seem that the problem is not a serious one and that the essential consideration is one of prevention which is really a problem of equipment and training."

The articles on immersion foot and frostbite for the *BULLETIN OF THE U.S. ARMY MEDICAL DEPARTMENT* were published in the November 1943 and December 1943 issues of this journal which reaches every medical officer in the Corps.

During the winter months of 1943–44 trench foot made its appearance in appreciable numbers among troops in Italy. In fact, during a period of 4 months the Fifth Army presented 1 case of trench foot for every 4 battle casualties, an exceedingly high ratio. The tremendous military significance of this condition immediately became apparent to many who before this time had not considered the subject a particularly grave one. Moreover, the importance of preventive measures was quite evident when the experience among British troops fighting in the same regions was compared with that of the American troops. There were very few cases of cold injuries among the British troops fighting in Italy at the time when the Fifth Army suffered such heavy casualties from cold.

The trench foot problem in Italy was carefully followed by the Surgical Consultants Division. All statistical data were studied and comparison struck with British experiences. On 19 June 1944 the Surgical Consultants Division prepared a memorandum for the Surgeon General in which paragraph 1 reviewed the unfortunate experiences in Italy of the preceding winter. Paragraphs 2, 3, and 4, of this memorandum are quoted here for the reader's consideration:

"2. It is apparent from these considerations that the trench foot problem is important, that our recent experience has been far from satisfactory, and that steps should be taken to prevent its repetition. The reasons for our unfortunate experience are quite apparent and consist essentially in the inadequacy of our program of prophylaxis. Primarily, it is due to inadequate instruction of personnel in methods of protection and the lack of provision of suitable equipment, especially shoes and socks. It must be recognized, however, that even after these measures have been met they must be put into effect by unit commanders, and personnel must apply them diligently if adequate protection is to be achieved. In the final analysis, this is a measure of discipline and responsibility of unit commanders.

"3. It is, therefore, recommended that a vigorous program directed toward the prevention of trench foot along lines which have proved to be effective be inaugurated by this office. This should include:

"a. The dissemination of information to troops on the hazards of exposure to wet and cold and the careful instruction of personnel in proper methods of prevention.

"b. The provision of proper equipment and footgear for operations in wet, cold regions. Efforts should be directed toward assuring the efficacy of this equipment.

"c. The direction of attention to unit commanders of the importance of foot discipline and of the diligent application of the protective measures.

"d. The dissemination of information to Medical Department personnel concerning the most authoritative knowledge on first aid and definitive treatment.

"4. The potential significance of injuries resulting from exposure to wet and cold such as frostbite, trench foot, and immersion foot were early realized by this office and have been given serious consideration. In a memorandum prepared by this office dated 23 August 1943, Subject: 'Revision in accordance with modern concepts of military publications on the subject of injuries resulting from cold,' a review of the current military publications on the subject was made and attention directed to their inadequacies. In a subsequent memorandum prepared by this office dated 16 October 1943, Subject, 'Frostbite, immersion foot and related conditions,' there was presented the results of a survey which was made by this office to determine the scope of the problem as well as to obtain the most recent authoritative knowledge on the subject, with the view of ascertaining the need for further study and for preparing, coordinating, and disseminating the best information on the prophylaxis and therapeusis of these conditions. The literature on the subject of the effects of cold was reviewed and representatives of this office participated in conferences of a special committee of the National Research Council for the purpose of evaluating the problem, reviewing the most modern concepts of the pathologic physiology, and determining the best principles of prevention and treatment. On the basis of the review of the literature and reports from authoritative and experienced individuals on this subject, and on the basis of concepts formulated by this special committee of the National Research Council, articles which incorporate the most authentic knowledge on frostbite, immersion foot, trench foot, and related conditions, and the most rational principles of prophylaxis and therapeusis were prepared by this office and published in the BULLETIN OF THE U.S. ARMY MEDICAL DEPARTMENT. These articles also form the basis of revisions which have been prepared for the various training manuals in cooperation with the Training Division for this purpose. At the time of this survey, it was concluded in the memorandum dated 16 October 1943, that while these conditions were not serious at the time, they deserved serious consideration because of their potential significance. It was also pointed out that 'the problem of adopting proper equipment for use in cold regions and the education of personnel in protection against hazards of exposure to cold is one that deserves greatest emphasis'."

Accordingly, The Surgeon General directed that a W.D. Circular (W.D. Circular 312 Sect. IV, dated 22 July 1944) be prepared by the training division on the basis of the information furnished by the Surgical Consultants Division. Furthermore, a TB Med (TB Med 81, 4 August 1944) presenting all phases of the subject was prepared by the Surgical Consultants Division for immediate distribution to all medical officers. Moreover, an article was published in the June 1944 issue of Health which again called attention to the experience in Italy and its important implications. The concluding statement read as follows: "A winter campaign in northwestern Europe could create a trench foot problem of major importance if the lesson of Italy were not heeded."

It was felt that these publications would serve to impress on all military sources the importance of the immediate need for rigorous action in the form of training soldiers and line officers on the preventive methods to be employed if a repetition of the MTO experience was to be avoided in Europe during the coming winter.

Despite these efforts, November of 1944 saw the beginning of another even more extensive trench foot episode, only this time in France and Germany. On 9 December 1944 another memorandum was prepared by this office for The Surgeon General in which the already alarming incidence of the condition in France was cited. The previous publications and correspondence of this division were once more reviewed and the recom-

mendations to The Surgeon General made in the 19 June 1944 memorandum restated. Paragraphs 3 and 4 of the 9 December 1944 memorandum continued as follows:

"3. In accordance with The Surgeon General's approval and direction, all of these recommendations were carried out by this office to the extent possible within the limits of its authority, as indicated by the following:

a. A War Department Circular (No. 312, Sec. IV, 22 July 1944) was prepared, setting forth the essential principles of control and emphasizing the command responsibility for their application.

b. Information to Medical Department personnel concerning the most authoritative knowledge on the subject, including the most rational principles of prophylaxis and therapeusis was disseminated through articles published in THE BULLETIN OF THE U.S. ARMY MEDICAL DEPARTMENT (page 26, November 1943, and page 46, March 1944) and a War Department Technical Bulletin (TB Med 81, 4 August 1944).

c. Conferences were held with representatives of the Q.M.C. concerning provision of suitable equipment for troops when fighting in cold, water-soaked terrain. Recommendations were made to the Q.M.C. on the proper type of heavy woolen socks and water-proof or water-resistant footgear.

"4. It is apparent from these considerations that this office has long recognized the military significance of the trench foot problem. Citing the unfortunate experience with this condition last winter, it was strongly urged in June 1944, that 'steps should be taken to prevent its repetition.' Accordingly, all the elements essential to an adequate control program were set forth by this office. However, the most important factor in assuring the success of this program is enforcement of these elements and this lies within the province of command rather than medical authority."

By the end of the winter some 45,000 soldiers had been incapacitated by trench foot. The number of these men capable of ever resuming full combat duty was so small as to be negligible. Thus the condition can be recorded as representing a most serious threat to the success of any military operation which requires men to remain in cold wet places for extended uninterrupted periods of time unless a well coordinated plan of prevention is enforced. Current statistical data were collected during the winter months from ETO by means of regular recurring radiograms. The information contained in these was carefully analysed by this division as well as others in the OTSG. Lt. Gilbert Beebe of the Control Division deserves great credit for the energetic and superb manner in which he presented the important data each month in the publication Health of which he is editor.

In March 1945 an article was prepared by Lt. Beebe with the cooperation of the Surgical Consultants Division entitled, "Cold Injury in Future Pacific Operations." Attention was directed to the recorded experiences with cold injuries among the Japanese troops during the Russo-Japanese War. The last paragraph of this article reads as follows:

"In the event that large-scale operations in regions of the Northern Pacific become necessary during the winter months, a repetition of the unfortunate experience with cold injuries in Europe can be prevented only by recognizing this danger and planning accordingly. The prompt provision of troops with suitable winter equipment, the energetic enforcement of individual foot discipline by line officers and the development whenever practicable of ways of providing rest periods during which combat troops can warm themselves, dry their footgear and other clothing, and obtain warm food or drinks, represent the necessary measures in any well-conceived plan designed to prevent this disastrous and crippling condition."

Early in April the Surgical Consultants Division was visited by Colonel Huncilman of ASF Plans and Operations for the purpose of obtaining information on the subject to be included in a letter from General Marshall to General MacArthur. This material was prepared by this division and coordinated with other interested divisions of the OTSG.

During the two winters when American forces were suffering heavy casualties from trench foot much was written, said, and done about this condition. In fact, an uncritical observer might readily conclude that despite all that was done a high incidence of the condition resulted and that trench foot, after all, is not preventable. Any historian or student of the subject who in the future may be reviewing the trench foot experiences of American Armies during this war in order to maintain a proper perspective must constantly ask himself two questions.

(1) What was the situation at the time this publication was printed or this action taken?

(2) Was the information in this publication or this action felt by line officers and soldiers in the field at a time when it would be effective?

Trench foot does not occur during summer months. It is a condition which occurs as a result of prolonged uninterrupted exposure to cold and wetness. In order for troops to protect themselves, they must be thoroughly educated and informed on the subject before those weather conditions are encountered. Training troops on a subject of this type after they are engaged in intensive combat is less effective than training them during a period prior to such action. The main concern of men engaged in combat is the preservation of their lives. Attempts to teach men under such conditions measures for preventing trench foot, which to them is seemingly unimportant at the moment, are not likely to meet with any great degree of success.

Thus as the war in the Pacific progresses and our troops are ever approaching a winter at geographic locations north of 32° latitude, the Surgical Consultants Division cannot help but wonder what training programs are being conducted among troops in the warm islands of the Pacific to inform them on the great importance of cold injuries and on the adequate measures for their prevention.

Anesthesia

There was a shortage of well-trained anesthesiologists throughout the war, and as a consequence considerable effort was necessary on the part of the Surgical Consultants Division to provide an adequate number of individuals who were capable of administering anesthetic agents. Mention has already been made of the schools of anesthesia which were conducted at civilian medical centers and of the final successful attempts to solve the problem of a scarcity of anesthesiologists by an on-the-job training program for medical officers and Army nurses at those Army hospitals having well-trained anesthesiologists on their staffs. A direct consequence of the sometimes desperate shortage of anesthesiologists was the danger to patients resulting from anesthetics given by individuals with little experience or training. It therefore appeared imperative to the Division that it evaluate, with the assistance of civilian and Army surgical consultants, the various anesthetic agents with particular view to safety and permit the use of only those considered the least dangerous. This was just as important in the field of local as in that of inhalation anesthetic agents. Based upon reports of deaths, apparently due to certain local anesthetic agents, it was directed that only procaine hydrochloride be used for infiltration anesthesia, and that agents for spinal anesthesia be restricted to procaine hydrochloride (preferable), Pontocaine (tetracaine hydrochloride), and Metycaine (piperocaine hydrochloride). At this time, a critical appraisal

of inhalation anesthetics was also made, and it was directed that the use of cyclopropane be discontinued.

The two most useful anesthetic agents under military conditions proved to be ether and Pentothal sodium (thiopental sodium). In an analysis of 7,500 cases of anesthesia, it was found that the death rate attributable to Pentothal sodium was six times higher than the death rate from all other anesthetic agents combined. This was regarded as an indication of the unwise use of Pentothal sodium rather than of its inadequacy for military purposes. The dangers of this agent were being overlooked. Immediate efforts were, therefore, directed toward better education concerning the use of Pentothal sodium by means of a circular letter to the field and by the publication of several articles in the *Bulletin of the U.S. Army Medical Department.* The conditions in military surgery in which Pentothal sodium had proved unusually valuable were emphasized, and those in which the drug should be either avoided or used with great caution were stressed. Attention was directed also to the importance of atropine in preoperative medication and to the administration of oxygen whenever feasible.

In matters concerned with anesthesia, Dr. Joseph Kreiselman of Washington, D.C., civilian consultant in anesthesia to The Surgeon General, and Maj. Lloyd H. Mousel, MC, Chief Anesthetist, Walter Reed General Hospital, were of inestimable value to the Medical Department. These two individuals worked in close cooperation and with their backgrounds in anesthesia and pharmacology provided excellent advice and consultation on many problems of anesthesia. They advised personnel on supplies and recommended the safest anesthetic policies and the most effective methods of resuscitation for adoption by the Army.

Traumatic Shock

Shock was obviously destined to play a large part in the mortality resulting from war wounds, and the proper management of this condition immediately presented itself as one of the most important problems of military surgery. The development of blood plasma was undoubtedly a great contribution to the treatment of shock, and by its use untold numbers of lives were saved. Unfortunately, the early enthusiasm that accompanied this development was so forceful that it clouded sound clinical judgment and led to the misconception, which persisted far too long, that plasma could be used as an effective substitute for whole blood in the management of shock. This misconception became so firmly entrenched in the minds of both administrative and professional personnel that it definitely handicapped the organization and development of more effective measures for the control of shock.

The British had discovered the fallacy in this thinking by the time the United States had entered the war, but, in spite of their experience, the U.S. Army was painfully slow in recognizing its error. As a matter of fact, the Surgical Consultants Division shared in this loose thinking for many months. It was due in large part to the reports from the surgical consultant in

NATOUSA that the Division was made to recognize its errors and to take steps to correct them. Reports from this source, based on increased experience and clinical and laboratory investigations, pointed out clearly that plasma could not be used as a substitute for whole blood and that whole blood was the agent of choice in the ultimate resuscitation of the majority of battle casualties. It became apparent that whole blood was the only therapeutic agent that could prepare seriously wounded patients to withstand the major surgery which was essential for saving life and limb. The transfusion of whole blood was more effective because not only did it restore blood volume as plasma did, but it also replenished the oxygen-carrying capacity of the blood by supplying red cells which plasma did not do. Plasma, however, was invaluable, for it could be used in emergencies or in the far-forward areas where it was not feasible to supply whole blood and it could tide a shocked patient over the critical period required for evacuation to some installation where whole blood was available. It became increasingly evident that both plasma and whole blood were extremely valuable in the management of shock but that both had their individual and specific purposes and, to be effectual, must be used accordingly.

Early in 1943, the problem of supplying whole blood to theaters of operations was discussed on several occasions with other individuals in the Office of the Surgeon General, and, though such a need was recognized in a vague sort of a way, it was not considered to be of great importance. Furthermore, the consensus was that it was impracticable to make whole blood available farther forward than the general hospital. In an effort to assist the theaters in supplying their own whole blood transfusions, equipment was made available to them and Circular Letter No. 108, Office of the Surgeon General, Transfusion of Whole Blood in the Theaters of Operation, outlining the techniques to be followed, was distributed on 27 May 1943. The surgical consultants in the North African and European theaters continued to stress the need for whole blood and emphasized the facts that casualties who had bled severely were poor surgical risks even though plasma had been administered in large quantities and that whole blood had to be given to them before they could be operated upon safely.

As a result of these urgent requests, the Surgical Consultants Division suggested strongly that transfusion sets, which had been developed at the Army Medical Center, Washington, D.C., be made available to the theaters immediately. These sets were expandable, were conveniently packaged, were easily usable and contained all the materials necessary for drawing and administering blood. In addition, refrigerators for the storing of blood in the field had been devised, and their procurement and issue were also recommended. This plan, which had been worked out down to the smallest detail, was rejected as being impractical and unnecessary. Finally, in May 1944, after several additional attempts, this plan was approved. The equipment was standardized and made available to the theaters.

During the many months which elapsed between the time that the need for whole blood became evident and the time at which the cited sets were made available, the Surgical Consultants Division had been interesting itself in the possibility of supplying whole blood directly to oversea installations from the Red Cross bleeding centers in the United States. After considerable experimentation and numerous conferences, the equipment necessary to such an effort was devised and perfected. Also, a plan was worked out with the Red Cross bleeding centers and with the Air Transport Command by which whole blood could be thus supplied. Consequently, when it became evident in mid-August 1944 that the European theater blood bank could no longer furnish sufficient amounts of whole blood, this plan, previously prepared, was approved by The Surgeon General and the first shipment of whole blood overseas was dispatched on 21 August 1944. Shipments were continued to the European theater until 10 May 1945, when further supplies were not needed. The shipments were then diverted to the Pacific theaters in conjunction with the Navy-operated whole blood program on the west coast. These were continued throughout the remainder of the war.

Another feature of shock which became apparent as experience increased was that concerned with certain of its lethal sequelae. During peacetime, shock is observed relatively infrequently, and experience with the condition never approaches the massive scale that occurs in war. The lethal sequelae are, therefore, less evident and tend to be less impressive. A number of battle casualties suffering from severe shock were found to die with manifestations of anuria or reduced urinary output. These lethal sequelae of shock were considered to result from asphyxia of organs or tissues during the prolonged period when the flow of blood was reduced in volume. Irreparable damage was demonstrated in the tissues of the brain, kidney, and, possibly, the liver of patients with delayed death resulting from shock. The Surgical Consultants Division was extremely interested in instituting field studies and in stimulating other studies in the United States concerned with the solution of this baffling problem. Considerable light was shed on the physiology involved in this complicated condition, although the problem was never solved in its entirety.[3]

War Wounds

Before their entry into the Medical Corps, the majority of military surgeons had had little experience with, and only a slight knowledge of, the management of the type of wounds which they were to encounter in the care of battle casualties. Hence, it was essential that they be informed of sound and proved methods of wound management and that these methods be emphasized repeatedly until they became thoroughly established. Two additional factors contributed to the need for education along these lines and for the strict enforcement of established rules and regulations.

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[3] Medical Department, United States Army. Surgery in World War II. The Physiologic Effects of Wounds. Washington: U.S Government Printing Office, 1952.

The first of these was the great variation in the training, experience, and ability of the medical officers who were engaged in military surgery. The second was the influence of Trueta's treatise which was concerned with the management of war wounds in the Spanish civil war. This work appeared shortly before World War II and created considerable interest. It was widely discussed by surgeons, and the techniques of debridement, immobilization by closed plaster casts, and wound packing with petrolatum-impregnated gauze had made a definite impression on them. Some surgeons in this country went a step further and, in certain extensive wounds seen in civilian life, practiced wide wound excision and primary closure. Many techniques of debridement appeared, and these varied from extensive excision of wounds to minimal removal of tags of devitalized or soiled tissue. Following these procedures, some surgeons closed the wound tightly by primary suture, while others left it open and either filled it loosely with gauze or packed it tightly.

Thus, it was evident that strong measures would have to be taken in the Army to insure the proper application of those principles of wound management which the surgical consultants, both in the field and in the Office of the Surgeon General, considered to be most suitable. It was necessary not only to lay down these principles but also to enforce their application. These purposes were accomplished by means of directives, communications, published articles, and addresses, but most importantly by the efforts of the surgical consultants throughout the Army. These principles of care of wounds are discussed in detail in many places in the other volumes of this history which are devoted to surgery. Their delineation, dissemination to medical officers throughout the Army, and their enforcement constituted a major contribution to the low mortality which occurred among the wounded and to the low incidence of serious infection, particularly of gas gangrene. It was the considered opinion of the surgical consultants that nothing could take the place of proper and adequate wound care in military surgery. Proper care was fundamental in the management of the wounded, and other measures such as transfusions of plasma or whole blood and the use of antibiotics and chemotherapeutic agents, effective as they were, were considered to be merely adjuvants.

Peripheral vascular injuries.—The Surgical Consultants Division repeatedly emphasized the frequency of peripheral vascular injuries, especially those involving major vessels, as an accompaniment of wounds of the extremity. The types of vascular injury and resulting sequelae were pointed out, and proper methods of dealing with each were described. These injuries occurred much more frequently than was commonly realized. This was indicated by the fact that vascular injuries were the cause for amputation of an extremity in approximately 20 percent of the cases in an extensive series which was analyzed by the Division in 1943 and 1944. Another indication of this fact was the increasing number of traumatic aneurysms which were operated upon at the vascular centers in the Zone of Interior. In connection with vascular injuries, the Division was active in calling attention to the importance

of vasospasm as a factor upon which the life of a limb may depend, particularly if the viability of the tissues had been impaired by traumatism. It also described methods for the detection of this condition and for its proper treatment.

Regional wounds.—As the war progressed and wider experience was had, newer methods were developed for the management of regional wounds. These were subjected to a critical evaluation based on the data received by the Division. Certain ones were considered to be of such value that they were described for the benefit of all medical officers and in many instances were made the subject of directives. Among them were such subjects as the treatment of injuries to peripheral nerves; the management of cranial-cerebral wounds; proper timing of operations upon spinal cord injuries; the management of wounds of the chest with special emphasis on the complications of hemothorax, tension pneumothorax, open pneumothorax, retained foreign bodies, and empyema; the treatment of combined wounds of the chest and abdomen; and the care of penetrating wounds of the abdomen with special reference to those involving the colon or rectum.

Chemotherapeutic agents.—All war wounds were considered to be contaminated, although the degree of infection varied from minimal surface involvement to invasive infection with regional or generalized extension. Mention has been made of the importance of the application of sound surgical principles in the prevention and treatment of infections. The story of the sulfonamides as a means of controlling infection in war wounds is an interesting one. Early in the war, these chemotherapeutic agents were widely heralded as "wonder drugs" and in the minds of many surgeons they were panaceas in the management of surgical infections. Much of this enthusiasm resulted from the glowing accounts of their use at Pearl Harbor, where they were credited with performing miracles in the prevention of infection and in its cure. The drugs were used both locally in the wounds and systemically. By the time the Surgical Consultants Division was authorized and organized, the Army had already purchased huge supplies of these drugs and had provided that each soldier carry a supply for local use in the powdered form and for systemic use in tablets. As soon after wounding as possible, the soldier was to sprinkle his wounds with the powder and to ingest the pills. The press was full of items indicating that this regime would afford remarkable protection to our fighting men and that many lives would thus be saved.

In the sobering light of critical studies and observations, however, this overenthusiastic concept regarding the value of these drugs began to be greatly modified. Grave doubt was cast on their beneficial effects when applied locally, and limitations were found in their systemic use. Surgeons in our Army and in that of the British began to veer sharply away from the introduction of the drugs in wounds and commenced relying more and more on their systemic effects. The range of organisms affected by these drugs was found to be restricted, and, from a military viewpoint, the most important organisms affected were the streptococcus and the gonococcus. In spite of this, the drugs

contributed greatly to the control of infections when used systemically and were highly regarded. If the antibiotics had not been discovered, the extensive use of the sulfonamides undoubtedly would have been continued throughout the war. They were thus utilized until the supplies of penicillin became adequate. The local application of these agents, a practice which was once widespread in the clean as well as the contaminated wound and which was a definite threat to the careful aseptic technique, fell into complete disrepute.

The Surgical Consultants Division played no part in contributing to the original misconception of the remarkable curative properties of the sulfonamides or for their distribution throughout the Army. When all this was taking place, the Division was not yet in existence. By the time the Division was functioning, doubt was already being cast on the propriety of the use of the drugs locally. Its role was to follow closely the clinical and experimental investigations, largely through the committees of the National Research Council, and to ascertain the limitations of these chemotherapeutic agents. As soon as these were defined, the Division was quick to take directive steps designed to insure the proper use of these agents in the Army.

The contributions of the Division to the penicillin program have already been enumerated. Streptomycin was discovered during the later phases of the war but was used almost entirely on an experimental basis until sometime after the war was over. A number of other agents for the control of infections were suggested to the Army from time to time during the war, and at times considerable pressure was exerted for their adoption and use. One of the important functions of the Division was to survey these suggested drugs critically, to evaluate them, and to recommend or discard them accordingly.

Gas gangrene.—Gas gangrene was recognized as one of the most serious infections which might occur as a result of war wounds. The mortality and morbidity from this infection at the outbreak of the war was therefore of the gravest importance. The sulfonamides did not prove to be effective in either the prevention or the cure of this condition, nor did penicillin, although for a time it appeared possible that penicillin had some effect in prevention due to its widespread effect on the accompanying pyogenic organisms. The most important factor in the prevention of gas gangrene was the proper surgical management of wounds in the early stages. This fact has been dealt with in previous paragraphs. The Division was much interested in the possibility of the successful production of a toxoid for the control of this infection and made strenuous efforts to arouse interest in this field. No such toxoid was developed during the war, but the efforts made at that time served as a stimulus for the continuation of investigation in this direction during the postwar period.

Pilonidal sinus.—While, strictly speaking, it may not be considered in the category of war wounds, the management of pilonidal sinus developed into one of the real problems of military surgery, particularly in Zone of Interior hospitals. Due to a lack of a uniform policy in the surgical care of this con-

dition, hundreds of thousands of man-hours were wasted in the first years of the war. There was a surprisingly large number of these cases among military personnel. Some cases showed no evidence of infection and were symptomless, but many more became infected, probably as a result of repeated trauma during the training period. The wards of Army hospitals contained many hundreds of these patients, and the majority had been hospitalized for weeks or months. The necessity for better defined methods of treatment for this seemingly minor surgical condition was completely overlooked and was appreciated only when manpower became scarcer and enough time had elapsed to indicate that man-days were being lost as a result of it.

In September 1943, a directive was issued by the Office of the Surgeon General indicating the type of operation which should be utilized. This was done because it was recognized at that time that many different types of operation were being performed, ranging from complete excision and primary closure to incision and drainage and packing with petrolatum-impregnated gauze. By September 1944, it became evident that even with these recommended operations the existing methods of management of pilonidal sinus were productive of extremely poor results. In support of this conclusion were the results of statistical studies, made in Army hospitals, of the end results of operative procedures. These indicated a loss of some 435,000 man-hours per year. On the basis of these findings, the therapeutic policies relating to this condition were revised extensively and expressed in War Department Technical Bulletin (TB MED) 89, Pilonidal Cyst and Sinus, dated 2 September 1944. This, in brief, directed that patients with uninfected pilonidal sinus were not to be operated upon and that those having infected sinuses were to be treated by simple incision and drainage. No excisions were permitted. Although this policy did not permit a permanent cure, it did allow a much more rapid return to duty and was preferable by far from a military viewpoint. Under the new regime the hospital stay was rarely more than 2 weeks, whereas under the older one many patients spent many weeks or even months in the hospital. It was true that repeated hospitalization was more frequent under the new regime, but, even so, many man-hours were saved. In retrospect, the importance of this relatively minor surgical condition should have been appreciated much earlier.

Thermal burns.—Thermal burns constituted a relatively small percentage of all battle casualties but were not without importance in military surgery. Accidental burns were more frequent among soldiers than among civilians of the same age group for the reason that the former necessarily handled gasoline and oil, grenades, and other types of ammunition. Airplane crashes, both in and out of combat, contributed to the incidence. The serious nature of extensive burns and the prolonged reconstructive surgery required in many cases further contributed to the importance of this problem. In 1943, for example, 25,609 patients were admitted to Army hospitals for the treatment of burns. Only 751 of these were received in combat, and 203 of the latter group occurred

as a result of airplane crashes. During the early part of the war, the tannic acid method of treating burns was the most commonly accepted. In January 1943, the Surgical Consultants Division, by The Surgeon General's Circular Letter No. 15, Treatment of Burns, recommended the pressure dressing technique as the most physiological procedure yet devised for the management of burn cases. Tannic acid was still permitted to be used in cases of burns except those of the face and hands. In September 1943, the tannic acid method was abandoned and prohibited by Circular Letter No. 161, Office of the Surgeon General. The pressure dressing technique, employing either boric acid or petrolatum-impregnated gauze, thus became the only method which was endorsed by the Office of the Surgeon General. In March 1945, the Division prepared TB MED 151 dealing with the surgical management of burns. This technical bulletin presented the accepted method of the systemic management of burns, plus an account describing the proper technique for applying an adequate pressure dressing. The Army's extensive experience with this method permitted the conclusion that it was highly effective in that it minimized plasma loss, prevented infection, minimized skin loss, prevented scarring, and saved lives.

Hospitalization

The policy of tranferring certain types of more difficult surgical cases from station hospitals to general hospitals was made during the first few months of the war, and it never ceased to be a cause of contention and irritation to surgeons assigned to station hospitals. Likewise, it created a situation which continually required firmness, combined with tact, on the part of the service command consultants, one of whose numerous duties was to enforce the policy. Many surgeons in station hospitals considered themselves entirely competent to operate upon patients who were being transferred, and in some cases this was true. On the other hand, there were many other surgeons in station hospitals who were not considered capable, on the basis of their training and experience, of giving acceptable surgical care to the more difficult cases. In the best interest of the greatest number of patients, the policy was required. At the beginning of the war, when there were quite a number of well-trained surgeons in station hospitals, complaints were more frequent and resistance stronger than later on, when many of these men were sent overseas. The Surgical Consultants Division was responsible for instituting the policy and for the decisions as to which cases were to be treated only in general hospitals. The Division was assiduous in carrying out the policy both through its own staff when on inspection trips and through the surgical consultants in the service commands. The policy was sound and was another evidence that The Surgeon General was making every effort to insure the best surgical care to Army patients.

This policy was further extended to make certain general hospitals into centers for the treatment of highly specialized cases. Specialized centers

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were established at first because of the fact that the hospitals thus designated had unusually well qualified specialists on their staffs and in many cases contained highly specialized and scarce equipment. In the beginning, there were very few of these centers and they were for the benefit of patients in general and station hospitals in this country. When the casualties from overseas began to be sent back to the United States in appreciable numbers, it began to be apparent that there was not going to be a sufficient number of specialists in many categories to care for them if they were sent indiscriminately to several general hospitals having only one or two such specialists. The Division, quickly realizing this fact, recommended that the centers be established in additional categories and that they be staffed with specialists drawn from as many Zone of Interior hospitals as necessary. Patients from overseas and from the Zone of Interior requiring special surgical care were all to be concentrated in these centers.

The plan was approved and put into operation. It was most successful for it permitted the greatest utilization of scarce categories of surgeons, and it made possible extremely productive investigative approaches to many important military problems such as those concerned with peripheral nerve injuries, deafness, vascular injuries, blindness, and amputations. The procedure also permitted the concentration of expensive, highly specialized, and scarce equipment into a few hospitals. With their specially selected staffs and their superb equipment, these centers made an outstanding contribution both to the care of patients with conditions requiring special management and to investigations in various special fields. The growth of these centers and their importance is illustrated in tables 1 and 2.

It is important to keep in mind when examining table 1 that in certain instances the beds allocated to the various specialties in hospitals previously designated as centers were numerically increased. Thus, the expanded activities in these special fields of surgery cannot be fully appreciated in terms solely of numbers of centers. Accordingly, the information on the total number

TABLE 1.—*General hospitals designated as specialized centers, December 1943 and August 1944*

Specialization	December 1943	August 1944
	Number	*Number*
Neurosurgery	13	19
Vascular	1	3
Thoracic	5	5
Amputations	4	6
Blind	1	2
Deaf	2	3
Plastic and ophthalmologic	4	8
Deep X-ray therapy	7	9
Radium therapy	2	3

TABLE 2.—*Authorized patient capacity for surgical specialties, June 1944 and June 1945*

Surgical specialty	June 1944	June 1945
Neurosurgery	3,044	18,655
Thoracic surgery	630	2,675
Plastic	868	6,849
Ophthalmologic	536	2,325
Blind	50	425
Amputations	1,470	7,725
Deaf	727	1,120
Deep X-ray therapy	326	400
Radium therapy	30	30
Vascular	334	1,481

of Zone of Interior beds devoted as of June 1944 and June 1945 to each of the specialties listed in table 1 is furnished in table 2 for comparison.

The creation of these specialized centers represented an effective solution to the problem of care of particularly complex cases or ones requiring specialized care or study. The care of such cases was greatly improved by this measure, and it represented a truly progressive innovation in the Medical Department's program which fostered specialized care by specialists.

SUMMARY

The Surgical Consultants Division began as a branch of a subdivision in the Office of the Surgeon General and emerged as an independent division directly advisory to The Surgeon General. Throughout the war, its many and varied functions were directed along the following two primary lines: (1) To determine the most appropriate surgical methods of caring for the sick and wounded and to see that therapy thus standardized was carried out uniformly, effectively, and thoroughly; and (2) to initiate and participate in administrative and logistic actions which would bring together the patient and the proper surgeon at the right time and in facilities adequately equipped and supplied to accomplish the task at hand.

A worldwide system of surgical consultants was established to realize these goals. Consultants in general surgery were on the staffs of each service command headquarters, with an additional consultant in orthopedic surgery where the caseload warranted his presence. Each theater of operations had its surgical consultants at the theater headquarters, and many had consultants in subordinate commands as well. There was a consultant in surgery in the medical section of the headquarters of each field army engaged in operations against the enemy. Additionally, eminent surgeons in the United States were appointed as civilian consultants, particularly in the various specialized fields of regional surgery where their knowledge and experience were indispensable.

Relationships between consultants in the Office of the Surgeon General and others in the Zone of Interior were close and direct, but, regrettably, relationships with consultants overseas were more indirect and distant.

The surgical consultants in the Office of the Surgeon General worked with and through many agencies and offices—military, governmental, and civilian. Of the nonmilitary organizations, there was an especially harmonious association with the Division of Medical Sciences, National Research Council, in the attempt to solve the many perplexing surgical problems of the war.

The remarkable surgical achievements of the war resulted in great measure from the establishment of this effective system of surgical consultants and the efforts of the men within this system.

CHAPTER II

Orthopedic Surgery[1]

Leonard T. Peterson, M.D.

ASSIGNMENT AND ORGANIZATION

Orthopedic Branch, Surgical Division.—Col. Leonard T. Peterson, MC, (fig. 4) was assigned as an orthopedic surgeon to the Surgical Division, Professional Service, Office of the Surgeon General, in September 1943. Upon reporting, he was given a friendly reception but no orientation or specific assignment of duties—probably because his was a newly created position. Almost immediately, a field trip was made with a group from the Office of the Quartermaster General to study the problem of rebuilt shoes. This trip proved to be very educational and a good introduction to the many duties which were to follow. Shortly thereafter, in December 1943, the Orthopedic Branch was officially established as a part of the Surgical Division. Colonel Peterson became chief of the Branch on 8 December 1943 and continued in this assignment and as consultant in orthopedic surgery to The Surgeon General until near the end of hostilities in 1945.

Physical Therapy Branch.—Physical therapy activities in the Office of the Surgeon General were made a responsibility of the Orthopedic Branch in December 1943 upon formal establishment of that branch. The chief of physical therapy, Maj. Emma E. Vogel, had extensive professional and administrative experience in this field and provided immediate supervision and direction of personnel and training activities concerned therewith. The orthopedic consultant assisted in matters of policy, directives, and publications. On all visits to hospitals, the orthopedic consultant inspected physical therapy activities and facilities. In February 1945, physical therapy activities in the Office of the Surgeon General were removed as a function of the Orthopedic Branch and made a separate Physical Therapy Branch under the Rehabilitation Division, Office of the Surgeon General.

With reference to physical therapy treatment of orthopedic patients, it was always recommended that the type and limitation of various treatments be determined by the surgeon responsible for the treatment of any particular

[1] This chapter, which covers the experiences and observations of the orthopedic consultant in the Office of the Surgeon General, was written 10 years after the termination of World War II. The writing was based upon personal records, official reports, and a vivid recollection of many of the events of that period. Perhaps it was better that such events be recorded after a lapse of time, when the important issues were more likely to receive emphasis and the less important problems seemed trivial by comparison.



FIGURE 4.—Col. Leonard T. Peterson, MC, Chief, Orthopedic Branch, Surgical Division, Professional Service, Office of the Surgeon General, and Consultant in Orthopedic Surgery to The Surgeon General.

individual. Obviously, close liaison was necessary between physical therapists and the ward surgeon responsible for the definitive care and disposition of a patient.

FUNCTIONS AND DUTIES

Personnel

Orthopedic surgeons.—An intimate knowledge was required of the qualifications, classification, and assignment of all orthopedic surgeons in the Zone of Interior. The orthopedic consultant recommended the initial assignment of orthopedic surgeons newly entering the service and, as necessary, recommended the transfer of key personnel. The recommendations were implemented through the Military Personnel Division. By reviewing the monthly rosters of general hospitals, replacement pools, and units leaving the United States for oversea duty, it was possible to keep informed as to the assignment of all orthopedic surgeons, who were classified A, B, or C according to their degree of skill and training. Almost without exception, it was found that

medical officers with orthopedic training were properly assigned. There were, however, a few instances of trained surgeons serving in administrative positions overseas, and one certified orthopedist was assigned to selective service duties in his home State. Every recommendation or complaint on the placement of orthopedic personnel was promptly investigated and corrected.

Enlisted orthopedic personnel.—Because of the shortage of trained enlisted personnel for brace and prosthetic shops, a survey was made of all qualified men in the Army, and their assignments were carefully scrutinized.

Civilian consultants.—A number of civilian consultants were utilized in the nine service commands, and their initial appointment and travel orders were executed in the Office of the Surgeon General. A few specially qualified amputees were designated as consultants for the purpose of visiting amputation centers and instructing new amputees. These included Mr. Charles McGonegal, Mr. Donald Kerr, Mr. Harold Carlson, and Mr. Walter Bura.

Disposition Procedures

Disposition from general hospitals.—Policies on the disposition and transfer of patients from and between hospitals in the Zone of Interior were established by The Surgeon General. The early discharge of patients to duty or placing them on leaves and furloughs meant a saving in hospital beds and hospital construction. Accordingly, one of the duties of the consultant in the Office of the Surgeon General was to uncover delays in disposition procedures and to expedite the discharge of patients. At the onset of the war, it was the practice to transfer patients no longer fit for military duty to the Veterans' Administration for treatment and discharge. It rapidly became evident, however, that the Veterans' Administration lacked the facilities and personnel to handle the large number of disabled. Furthermore, patients objected strenuously to discharge from the Army until they had reached maximum improvement. They felt that they received better care in the military hospital, and, in some instances, their incomes decreased upon separation from the service. This led to a change in procedures late in 1943 which called for the keeping of patients under military control until they reached maximum improvement. This plan necessitated extremely long hospitalization in many orthopedic cases. Delay in the disposition of patients was a common deficiency. The problem was not peculiar to the war period, for it has been observed in military and civilian hospitals before and since that time. Delays in disposition assume greater importance in times of emergency, however, and all personnel must be alert to the importance of keeping hospital time, per patient, down to a minimum.

Interhospital transfers.—Another frequent observation was the unnecessary transfer of patients from station to general hospitals. In the wards of general hospitals, many patients were seen who did not require general hospital care—patients who should have been returned to duty from the sta-

tion hospital. Additionally, convalescent hospitals were established to care for patients who did not need general hospital care and yet were not ready for discharge. But, with the increasing demand for hospital beds, many patients were sent to these convalescent hospitals only to be readmitted to a general hospital at a later date for additional definitive treatment. Qualified personnel were therefore required in convalescent hospitals properly to evaluate these cases before a decision was made as to their disposition—duty, discharge from the service, or readmittance to a general hospital. In many instances, time was lost in the disposition of patients when those who could have completed their definitive treatment at a general hospital and could have been discharged directly from the general hospital were needlessly transferred to convalescent hospitals.

Communications

Preparation of policy directives.—Professional policies were largely determined at the hospital level in the Zone of Interior. In a few instances, directives on orthopedic policies and practices were published by The Surgeon General. One directive prepared by the consultant in orthopedic surgery for publication by The Surgeon General applied to the open treatment of compound fractures. Another applied to the principle of open amputation where amputation was required for infection or severe mutilating injury. The development of sulfonamides just before the war had led surgeons in civilian life to treat open fractures and emergency amputations by wound closure. The application of the same principles in war surgery, however, had led to disastrous results. Thus, it was necessary to promulgate these instructions directing that compound fractures and emergency amputations not be subjected to wound closure.

Preparation of War Department Technical Bulletins (TB MED's).—TB MED's were prepared from time to time as necessary in the Office of the Surgeon General. These bulletins were informative and advisory in nature. The consultant in orthopedic surgery prepared TB MED's on knee surgery, materials for open reduction, and the care of amputation stumps.

Editorial review and professional assistance.—All professional papers submitted for publication which pertained to orthopedic subjects were reviewed by the orthopedic consultant. Assistance was given authors in preparing papers for submission to publishers. Disposition and retirement proceedings reviewed by the physical evaluation review board in the Office of the Surgeon General were often referred to the orthopedic consultant for opinion.

Correspondence for The Surgeon General.—Of the many letters received by The Surgeon General, those pertaining to orthopedic problems were referred to the orthopedic consultant for review and reply. It was necessary to answer all these letters in a specific and courteous manner. Occasionally, very long and involved letters were received from obvious cranks. Such let-

ters were disposed of in as simple a manner as possible in order to avoid involvement in an endless and useless correspondence.

Field Trips

Approximately one-third of the patients in general hospitals in the Zone of Interior were charges of the orthopedic service. In many instances, the orthopedic census in a hospital exceeded 1,200 patients. Thus, nearly one-third of Colonel Peterson's time was spent on field trips visiting general and regional hospitals. Visits were made one or more times to all but 5 of the 65 general hospitals which were eventually established for the hospitalization of the U.S. Army. It was often apparent that the hospitals were burdened by the number of visiting consultants and inspectors in administrative and professional roles from various echelons. As a visitor from the Office of the Surgeon General, the author was always received with a spirit of courtesy and cooperation. A few unpleasant experiences were encountered and these were probably due as much to the overzealousness of the consultant as to local conditions. As a rule, the commanding officer and his staff of an installation being visited made it possible for the visiting consultant to complete his mission in a pleasant and expeditious manner.

These hospital visits of 1 to 3 days' duration were made to inspect the orthopedic service, to review the professional work, and to determine the need for personnel and equipment. Ward rounds were made, and each patient was briefly examined with a review of his X-ray file. Details of previous treatment and proposed treatment and disposition of individual patients were made a matter of concern. General principles of treatment and policies pertaining to the military-medical situation were frequently discussed.

It was interesting to note the patient's response and his appreciation of the individual attention which the visiting consultant might show in his case. All the patients on the ward were obviously attentive and interested in any comment which might be overheard. It would, no doubt, have been interesting to have heard the comments the patients made subsequently in their discussion of the consultant's visit, but unfortunately—or fortunately—these are not a matter of record. Great care was necessary during such a brief visit to insure that comments and impressions did not reflect unfavorably on previous treatment of the patient. Every effort was made to reserve questionable details for private conference where any errors or omissions could be reviewed in detail.

Upon the orthopedic consultant's return, brief reports on the hospital visits were made to The Surgeon General and forwarded through channels to the hospital. In five instances, it was recommended that the chief of the orthopedic section in a general hospital be replaced. Although several objections were raised to this change in personnel, the replacements were approved to the ultimate satisfaction of the commanding officers involved.

Supplies and Equipment

Scope of duties in connection with supplies and equipment.—Among the important duties of the orthopedic consultant in the Office of the Surgeon General were those concerned with supplies and equipment. For example, it was necessary to catalog and standardize the entire list of equipment and material necessary for orthopedic braceshops. In cooperation with the supply division, this was accomplished, and a satisfactory system of supply for these shops was established. Artificial limbshops presented a special problem with the growing demand for prostheses and for research and improvement in prostheses. Seemingly minor items such as hinge joints and rubber bumpers proved to be very important in the function and durability of an artificial limb. Surgical instruments, fracture tables, plaster bandages, and numerous other items required constant, almost daily liaison with the supply division. Writing specifications and planning procurement of items related to orthopedic surgery was a never-ending activity.

Innumerable items of equipment and suggestions for new items were referred to Colonel Peterson if they pertained to orthopedic treatment. The enthusiasm of the inventor usually bore no direct relationship to the appropriateness of his device for use in the military service. Although many of the devices, such as splints, arch supports, special shoes, and prostheses, were not adaptable to military requirements, it was necessary to be constantly on the alert in order not to disregard appliances or suggestions of definite merit. For example, one manufacturer of arch supports maintained that every soldier should be equipped with at least two pairs of his supports, since wars were won or lost on the soldier's ability to march and surely this ability would be greatly enhanced by his product. Another item was a special shoe constructed with coil springs in the sole which would, according to the designer, relieve fatigue and unpleasant impact when the wearer ran or jumped. Numerous substitutes were proposed for Army splints and plaster of paris but were usually without merit.

During the early years of the war, there was a lack of certain items of operating-room equipment which, in many instances, was due to the individual methods and requirements of the surgeon. Many instruments which had been nonstandard before the war had to be rapidly standardized and rushed into manufacture and procurement. It was necessary to adopt the policy to obtain instruments which would suffice for the greatest number, rather than to meet individual demands. For example, in standardizing equipment for hip nailing, the cannulated three-flanged nail was adopted. An eminent authority on this subject requested The Surgeon General to change from the cannulated to the noncannulated hip nail. This was a case where the recommendation was not consistent with military needs, and was not adopted. At another time, some defective Steinmann pins were supplied by one manufacturer, and many of these pins broke. The situation required immediate correction.

Similarly, plaster of paris was initially supplied in bulk, and plaster bandages were prepared locally in Zone of Interior hospitals. This procedure required hospital space and personnel needed for other purposes. At the same time, factory-rolled bandages were being shipped overseas. It became apparent that factory-prepared bandages were more economical and of better quality, but, in spite of the efforts of the orthopedic consultant, it was not until near the end of the war that they became available for hospitals in the Zone of Interior.

Special problems and projects.—An orthopedic equipment problem requiring special investigation and administrative effort by this author was that of plates and screws for internal fixation. In 1943, it was discovered that plates and screws for internal fixation were defective and that the existing specifications and standards were inadequate. With the cooperation of the National Bureau of Standards, Department of Commerce, extensive testing was done on plates and screws—testing which ultimately led to improved specifications and the procurement of better products. This had a definite influence on the manufacture of these items after the war and led to improved plates and screws for both military and civilian use.

Another problem requiring similar action by the consultant in orthopedic surgery was the need for special shoes for foot deformities. The need for such shoes became increasingly important with the return of battle casualties. The manufacture of special shoes from ordinary measurements or plaster casts had proved inadequate. With the cooperation of the Quartermaster General, a system was designed to obtain casts and measurements from an impression of the foot in magnetized steel balls which retained the weight-bearing imprint until a cast was made. Next, personnel had to be trained in this technique to staff six centers which were designated for providing special shoes. With rapid demobilization after the war, this method was subsequently discarded.

Prostheses were a definite problem throughout the war years. It was the practice to obtain various types from manufacturers, and further fabricate them in local limbshops. But specifications for artificial limbs and accessories were very meager, and often items supplied were deficient in some respect. There was not sufficient inspection of the prostheses at the source to guarantee the desired quality. The lack of quality, however, was often due to difficulty in obtaining experienced personnel and necessary materials. These comments are not intended to reflect upon the supply services or manfacturers but are made in the interest of better procurement for any future emergency. Without adequate specifications, mass production, and careful inspection, it is not possible to supply adequately the needs of many thousands of new amputees in a country at war. Research and development on prostheses conducted during World War II and immediately thereafter are discussed in the paragraphs on amputations, which follow.

Facilities

As in the matter of equipment, there were also deficiencies in hospital facilities for the care of orthopedic patients. Perhaps the lack of facilities was more accentuated than that of equipment. Hospital plans had provided no plaster room. Through some misconception, a small plaster dispenser of a dental type was installed in the X-ray service for orthopedic use. It became necessary to use at least half of a hospital ward to furnish adequate plaster- and dressing-room facilities for orthopedic patients. Braceshop and X-ray facilities also were insufficient for the rapidly expanding number of orthopedic casualties. These deficiencies were gradually corrected as new hospitals were designed and built, and the consultant in orthopedic surgery shared in the efforts to effect these improvements.

AMPUTATIONS

Amputation Centers

Establishment of amputation centers.—The orthopedic consultant's initial and, perhaps, foremost duty was the supervision and coordination of activities pertaining to amputations and prostheses. Five amputation centers were designated in March 1943 at the following Army general hospitals: Walter Reed General Hospital, Washington, D.C., Lawson General Hospital, Atlanta, Ga., McCloskey General Hospital, Temple, Tex., Percy Jones General Hospital, Battle Creek, Mich., and Bushnell General Hospital, Brigham City, Utah. The amputation center at Thomas M. England General Hospital, Atlantic City, N.J., was established in August 1944. The seventh, and last, center was designated at McGuire General Hospital, Richmond, Va., in January 1945.

In 1945, amputees among Philippine soldiers came to the attention of The Surgeon General. These amputees were entitled to the same benefits of surgery and prosthetic fitting as others of the Armed Forces of the United States. Accordingly, it was necessary to provide for their treatment in the Philippine Islands[2] or to transfer them to amputation centers in the United States. A plan was formulated in the Office of the Surgeon General in February 1946 to send a unit to the Philippines to establish an amputation center. This unit, organized by Colonel Peterson, included 3 officers (1 of whom was an amputee), 2 occupational therapists, 1 physical therapist, and 16 enlisted men trained in limb fitting. This group sailed from San Francisco on 18 April 1946 with necessary shop equipment and established an

[2] Parsons, W. Barclay, Trimble, I. Ridgeway, and Eaton, George O., Southwest Pacific Area. *In* Medical Department, United States Army Surgery in World War II. Activities of Surgical Consultants. Volume II. Chapter XII. [In preparation]

amputation center within 4 weeks of arrival in the Philippine Islands. A total of 192 amputees were treated, and there were 94 operations and 118 prosthetic fittings before the group departed in October 1946. A complete amputation center with equipment and trained Philippine personnel was tranferred to the local authorities to meet the needs of the military and civilian amputees remaining.

Amputation statistics.—On the basis of information derived from reports received from amputation centers, the Medical Statistics Division, Office of the Surgeon General, has estimated that about 15,000 men in the U.S. Army (including Army Air Forces) suffered amputations during the period from 1 January 1942 to 31 March 1946. The maximum census reported by these amputation centers for any one month was 9,246 in June 1945. The total number of amputees included in these reports was 14,782, broken down as follows:

Single amputation:		
One leg	10,620	
One arm	3,224	
		13,844
Double amputation:		
Both legs	870	
Both arms	57	
		927
Triple amputation:		
Both legs, one arm	8	
Both arms, one leg	1	
		9
Quadruple amputation		2
Total		14,782

It should be noted that these estimates do not include nondisabling amputations of fingers or toes of U.S. Army personnel who, after treatment, were continued in military service. Moreover, these estimates, based on reports received from amputation centers in the Zone of Interior, exclude data on those amputees who did not reach these centers; for example, amputees who died overseas.

Operation of amputation sections at centers.—Few doctors had much experience in amputations or prosthetic fitting before their military service. They rapidly gained experience, however, and attained very high standards of amputation surgery (fig. 5). With the aid of visiting medical consultants and representatives of the prosthetic industry, officers and enlisted men were trained in details of prosthetic fitting. Medical officers assigned to the amputa-



FIGURE 5 Amputation of upper extremity. A Amputation site B Fitted prosthesis C Limb fabrication for double amputation.

tion sections were responsible for the surgery, postoperative care, prosthetic fitting, and rehabilitation of the amputees. Each medical officer on the amputation sections at the centers had from 75 to 100 patients under his care, which was more than an average workload.

Informal monthly reports were sent to the consultant in orthopedic surgery in the Office of the Surgeon General from each amputation center. These one page reports designated the various types of amputations and surgical

procedures being carried out and the prosthetic fittings being used and included statistics on admissions, dispositions, and census. Each report was obtained directly from the chief of the amputation section in spite of occasional protests from various sources. It was believed that this method of direct reporting was justified, since amputations constituted a special problem in which close liaison was necessary between the orthopedic consultant in the Office of the Surgeon General and each officer in charge of an amputation section at the centers. These reports supplied valuable information with the least possible delay.

Conferences.—Several conferences were held during the war years on amputation centers and amputation activities. An international conference met in Ottawa and Toronto in February 1944. Chiefs of the centers met on three occasions during national orthopedic conventions in 1944 and 1945. A conference was held in Washington, D.C., and at McGuire General Hospital in June 1945 to consider amputation technique, prosthetic problems, the history of amputations in World War II, and projected research and development.

Research in Artificial Limbs

Committee on Artificial Limbs.—Research in artificial limbs was almost nonexistent before 1945. Prostheses had gradually evolved through the efforts of individual manufacturers. The available prostheses were quite satisfactory for the lower extremity. From both the cosmetic and functional standpoint, the devices for the upper extremity were still inadequate. At the request of The Surgeon General, the National Research Council established the Committee on Prosthetic Devices (later called the Committee on Artificial Limbs) in February 1945. It was hoped that this committee would help to improve rapidly the specifications and manufacture of prostheses for the military service. This, however, proved to be a long-range research program, and the work of this committee did not actually benefit the amputees in 1945 and 1946 or for several years thereafter. Meanwhile, the U.S. Army established the Army Prosthetics Research Laboratory at the Walter Reed Army Medical Center, Washington, D.C., in August 1945, and the work of this laboratory has resulted in greatly improved cosmetic and functional hands (fig. 6). The Committee on Artificial Limbs continued to be supported by the Veterans' Administration and the U.S. Army in the conduct of research by contract with universities and manufacturers during the postwar years.

Commission on artificial limbs.—In March and April 1946, a commission on artificial limbs directed by Colonel Peterson and including Maj. Rufus H. Alldrege, MC, and Dr. Paul Klopsteg, chairman of the Committee on Prosthetic Devices, visited Europe for the purpose of studying amputations and prostheses. The tour included England, France, Germany, Switzerland, and Sweden where numerous amputation centers and limbshops were observed.

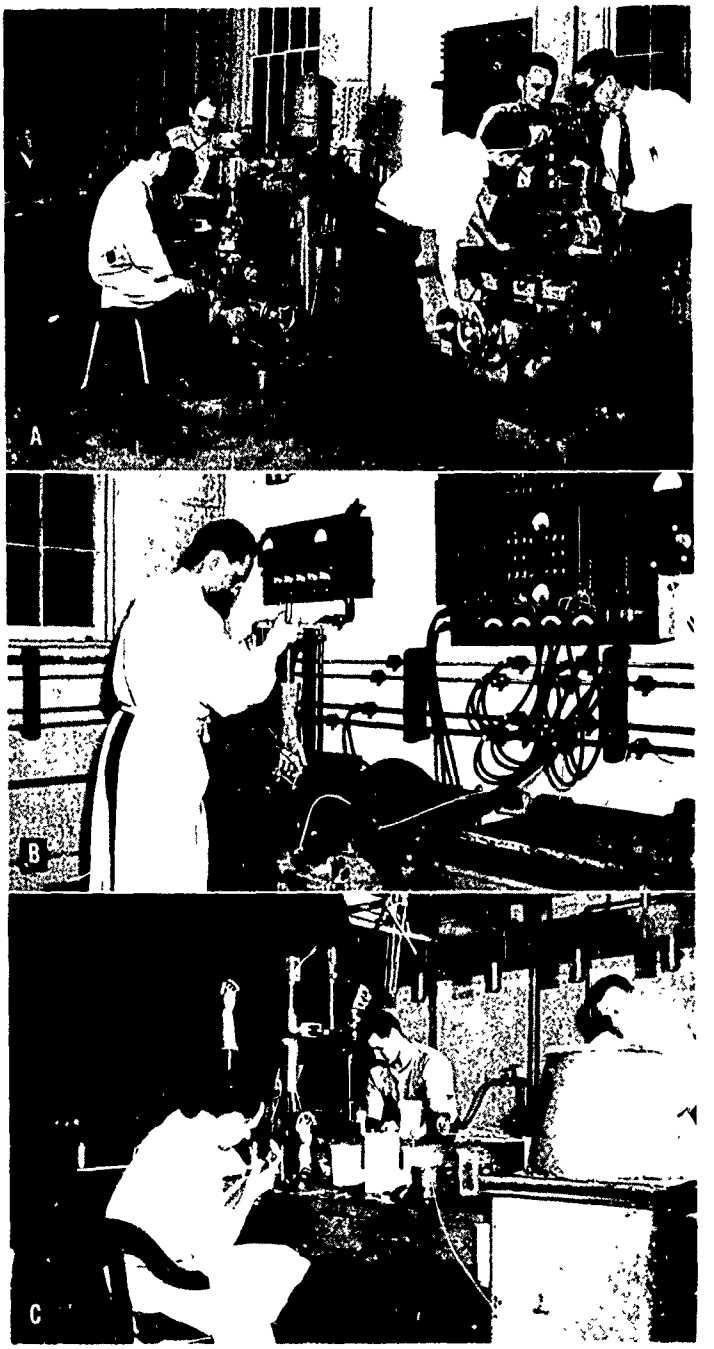


FIGURE 6.—Army Prosthetics Research Laboratory. A, Machine shop. B, Electroforming mold for cosmetic glove. C, Finishing cosmetic gloves in the processing laboratory.

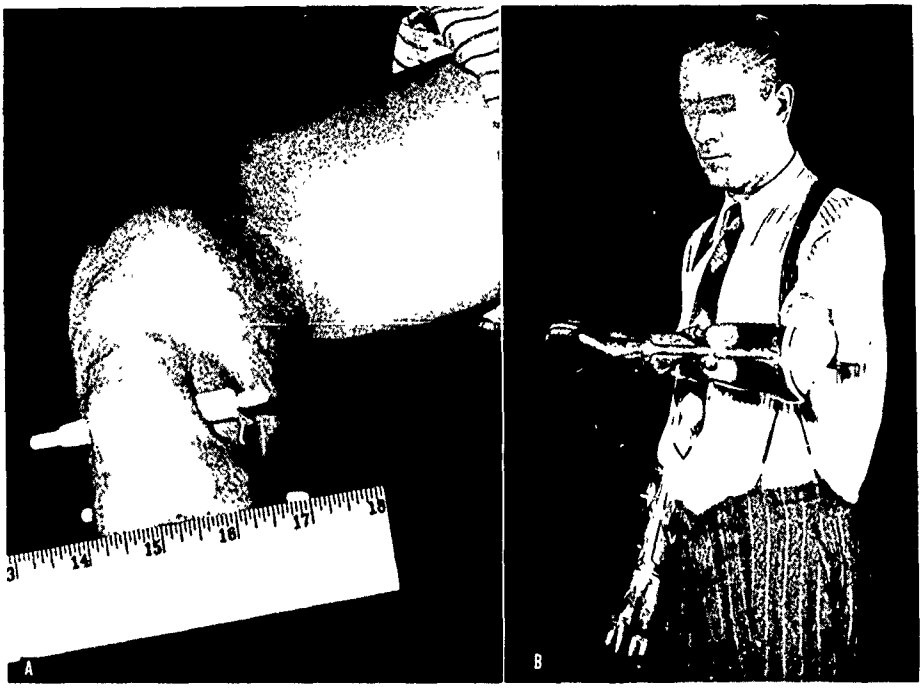


FIGURE 7 Cineplasty surgery and prostheses, Sauerbruch type. A, Cineplasty, proximal third of forearm, end view. B Prostheses with Hufner hands, flexed.

Two developments received special attention by the commission during its tour. One was cineplasty for the upper extremity (fig. 7), and the other, suction sockets for the lower extremity (fig. 8). Subsequently, both subjects underwent intensive research in the United States and the principles were applied with increasing popularity after World War II.

LIAISON AND COOPERATIVE ACTIVITIES

Within the Office of the Surgeon General.—There was excellent liaison and cooperation between the orthopedic consultant and the various divisions of the Office of the Surgeon General. Records in the Military Personnel Division, Personnel Service, Office of the Surgeon General, were available at all times for review. Recommendations made by the consultant for the assignment and transfer of orthopedic personnel were implemented by the Military Personnel Division, without delay. The Physical Standards Branch, Medical Division, Professional Service, frequently consulted the Orthopedic Branch with reference to standards on the musculoskeletal system as applied to enlisted and commissioned personnel. Frequent informal conferences were held with representatives of the Medical Supply Division, Supply Service, Office of the Surgeon General, on specifications, requirements, and procurement



FIGURE 8.—Suction-socket artificial limb with two-way valve (J. A. Hanger) developed from German prototypes. A. Lateral view of prosthesis. B. Amputee and prosthesis. C Fitted prosthesis.

of all orthopedic supplies and equipment. The Medical Supply Division endeavored to meet every need for the proper professional care of orthopedic patients.

There were many conferences and cooperative projects with the Training Division, Operations Service. These related to the preparation of training and field manuals, especially on such matters as first aid, transportation of the wounded, and other technical training subjects. A number of motion pictures were made, in conjunction with the Training Division, on orthopedic topics. There was a documentary film for amputees, "Swinging into Step." Several motion pictures, such as "Meet McGonegal" and "Diary of a Sergeant," pertained to upper-extremity amputees. Other motion pictures and filmstrips covered the technical aspects of amputation surgery and the care and training of amputees. A film, "Plaster Casts," was made for the training of plaster-room technicians and other personnel.

With the service commands. The relationship of the consultant in the Office of the Surgeon General with the various service commands was of considerable importance. The service command surgeon was naturally desirous of maintaining his authority and integrity and, on occasion, objected to direct communication between the orthopedic consultant in the Office of the Surgeon General and consultants or hospital personnel within his service command.

On several occasions, criticism was directed through channels to The Surgeon General because of direct communication by telephone or letter, from the orthopedic consultant in the Office of the Surgeon General to the chief of orthopedic service in a hospital. Nevertheless, many problems and questions arose which could have been, and were, expedited through direct communication without impairing the prestige or authority of commanding officers of hospitals or surgeons of service commands.

OBSERVATIONS ON CARE OF ORTHOPEDIC INJURIES

Errors and omissions were occasionally observed in the professional care of patients with orthopedic injuries. In general, the standards of treatment were exceptionally high and surgical technique was excellent. The residency training program in civilian hospitals had furnished sufficient trained orthopedic surgeons so that several were available for each of the larger hospitals. Their assistants, who had had 1 or 2 years of formal training, and others, who were rapidly trained in the Army, became proficient in their assignments. In spite of the heavy workload carried by the individual orthopedic surgeon in a hospital—from 75 to 100 patients per medical officer—serious delay in surgical treatment or disposition was rarely encountered. The following observations were noteworthy:

Overtreatment.—Several aspects of overtreatment were common. In the early months of the war, many upper-extremity injuries had extensive immobilization of the hand which prevented active use of the fingers, especially at the metacarpal-phalangeal joints. This resulted in unnecessary stiffness and prolonged incapacity. The consultant directed that prompt attention be given to mobilization of the hand at the proximal palmar crease in order to avoid fibrous ankylosis of the metacarpal-phalangeal joints. Some undisplaced fractures of the long bones which were not in danger of displacement or nonunion were overtreated by prolonged immobilization. For example, undisplaced fractures of the head and neck of the humerus, the head of the radius, and the pelvis and march fractures of the foot required minimal immobilization.

Internal fixation of compound fractures.—Compound fractures required emergency surgery and debridement. When it was necessary to delay the emergency surgery, in some instances internal fixation was performed several days later after the optimum time and yet before the danger of infection had passed. When the debridement and fixation could not be performed immediately, it was not advisable to apply internal fixation until the wound had completely healed. Failure to observe this principle resulted in osteomyelitis and prolonged morbidity.

Fractures of the femur.—Fractures of the femoral shaft were immobilized in a plaster spica for transportation to the Zone of Interior, where the cast was removed and the femur was placed in traction and balanced suspension

until union was firm. If the cast was maintained too long, considerable stiffness and atrophy resulted. If traction was removed before union was firm, deformity or nonunion followed. It was often demonstrated that both the clinical and X-ray examinations were essential to establish the degree of bone union. Occasionally, X-ray suggested union while clinical examination revealed definite nonunion.

Delays in operation.—Delay in operation was noted in three types of cases which deserve special mention. First, chronic osteomyelitis with sequestration was often treated conservatively after operation was indicated. Next, chronic skin ulceration was allowed to continue after skin grafting was indicated to hasten recovery. On the other hand, this author observed that the principle of early sequestration followed in a few days by skin grafting of the saucerized wound was especially noteworthy on the service of Dr. Robert P. Kelly, Jr., at Ashford General Hospital, White Sulphur Springs, W. Va. Finally, many cases with definite meniscus injury were continued unnecessarily long on conservative treatment when surgery was unquestionably required. The delay in surgery for injured meniscus was a reaction to the frequent arthrotomy which was noticeable in the early months of the war when cases had not been carefully selected and no postoperative rehabilitation had followed. The long-established principle of meniscectomy for internal derangement had unjustly lost stature. Fracture or dislocation of a meniscus was a very common injury among military personnel, and the need for surgical treatment was usually obvious.

Rehabilitation.—The importance of rehabilitation was nowhere more apparent than in the postoperative meniscectomy cases. In early hospital visits, only a few places had an adequate rehabilitation program. While the need for this rehabilitation had long been recognized in the military service as an essential part of the postoperative care, repeated emphasis and education were necessary before the principles of quadriceps exercise were generally recognized and applied. An outstanding example of a good rehabilitation program in postoperative knee cases was observed in 1943 on the service of Maj. (later Lt. Col.) Robert L. Preston, MC, at Nichols General Hospital, Louisville, Ky. The later development of a resistance exercise program is attributed to the work of Capt. Thomas L. De Lorme, MC, and Maj. Francis E. West, MC, at Gardiner General Hospital, Chicago, Ill.

SUMMARY AND RECOMMENDATIONS

Orientation to duties.—At the time of his assignment, a professional consultant should be rapidly but thoroughly oriented in his duties and in the limitations of his assignment.

Hospital visits and inspections.—Consultants must spend a great deal of time in travel under hardship conditions that are not readily apparent. Wartime travel and accommodations were fairly rugged even in the Zone of

Interior. A clean room with a comfortable bed, one easy chair, and a good lamp were minimal accommodations which were not always available. The hospitality to the visiting consultant contributed considerably to warm relations during his inspection. The reception given to the consultant in the "front office" of a hospital being visited was often an indication of the spirit of the command. The visitor had to be prepared for the occasional cool reception by a hospital commander who was too harassed by other important problems.

Hospital inspections were very strenuous when they involved, as they usually did, the examination of several hundred patients daily and the evaluation of professional personnel. Consequently, it was necessary to put hospital personnel at ease as early as possible during the inspection. The sudden descent on a hospital of a large number of consultants as in the wartime "Flying Circus" trips must have left the hospital a little washed out after the visit was completed. These massive inspections often lacked the atmosphere of personal contact, and, in the opinion of the writer, the mission could have been better accomplished by a less explosive type of inspection.

The amputee.—Among the various types of battle casualties, amputees presented a unique problem. The emotional and physical disturbance resulting from the loss of one or more limbs required a prolonged period of treatment and readjustment. The congregation of a great many amputees, with their multiple problems in prosthetic fitting and training, presented a public relations problem of considerable magnitude. An extensive file of headlines and newspaper articles pertaining to amputees was a constant reminder of the necessity of meeting this problem with a planned program in personal and public relations. The writer is hopeful that continuing programs in prosthetic research will furnish good prosthetic devices, and thus obviate some of the difficulties of World War II. Nevertheless, comparable problems in prosthetic fitting, rehabilitation, and social readjustment of the amputee are likely to recur in a time of all-out war.

CHAPTER III

Chemical Warfare

George R. Greenwood, M.D.

Although active chemical warfare was never initiated in World War II, preparation for it was begun early by various agencies of the Federal Government and was continued on an increasing scale until the end of the war with Japan. This was only logical. It was well known that the enemy was equipped to institute this kind of warfare. Furthermore, the argument was frequently heard that the U.S. Army would be justified in instituting it in order to prevent unnecessary casualties among its own troops. Had either of these contingencies come to pass, it would have been the responsibility of the Medical Department to care for the casualties of chemical warfare. Even before the United States entered the war, therefore, planning along these lines had been undertaken.

CHEMICAL WARFARE BRANCH, OFFICE OF THE SURGEON GENERAL

When the United States entered World War II, the Army Medical Department owned and financed, but did not operate, the medical laboratory at Edgewood Arsenal, Md. (fig. 9). This laboratory, which conducted research studies on the treatment of casualties caused by chemical agents, maintained liaison

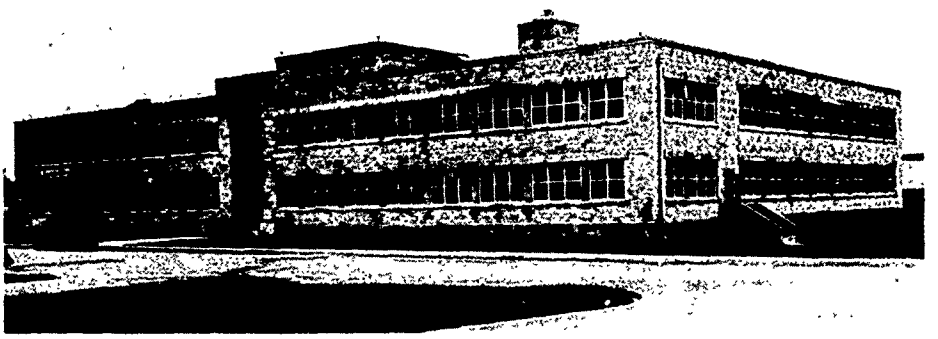


FIGURE 9.—Army Medical Laboratory, Edgewood Arsenal, Md.

with the Chemical Warfare Service of the Army and kept The Surgeon General informed on current developments. At that time, no medical officer was assigned to his office.[1]

Appointment of Medical Liaison Officer

After 7 December 1941, when the possibility of chemical warfare became an acute reality, the volume and pace of the work done at the medical laboratory at Edgewood Arsenal increased, and a corresponding need arose for direct representation of the Chemical Warfare Service in the Office of the Surgeon General. To meet this need, Lt. Col. (later Col.) John R. Wood, MC,[2] chief of the medical laboratory at Edgewood Arsenal, was appointed to the Surgery Division, Office of the Surgeon General, on 21 May 1942, and was officially designated as liaison officer representing The Surgeon General to the Chemical Warfare Service.[3] On 18 December 1942, however, Colonel Wood was transferred to Edgewood Arsenal, and, from then until August 1943, there was no representative from the Office of the Surgeon General to the Chemical Warfare Service.

In November 1942, when research in chemical warfare was being expanded rapidly in response to the potentially urgent need of the Army, three groups were engaged in the study of the medical aspects of this type of warfare, as follows:

1. The Office of Scientific Research and Development had two committees at work in this field. The National Defense Research Committee investigated the effects of new chemical agents. Clinical studies were conducted when they were practical, and the agents were studied experimentally, by observation of the physiologic mechanisms involved and the possible immunochemical reactions. The Committee on Medical Research developed methods of treatment for chemical injuries.

2. The Medical Research Laboratory, Edgewood Arsenal, in addition to carrying out a variety of peculiarly military scientific functions, made studies similar to those made by both the committees of the Office of Scientific Research and Development. In other words, the functions of the former duplicated those carried out by the civilian agency.

3. The Medical Department of the Army had the responsibility of treating injuries due to toxic and incendiary agents.

The development of chemical agents and the protection of troops against them was the responsibility of the Army Chemical Warfare Service.

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[1] Office Order No. 87, Office of the Surgeon General, U.S. Army, 18 Apr. 1941

[2] Office Order No. 175, Office of the Surgeon General, U.S. Army, 1 June 1942.

[3] Letter, Chief, Medical Research Division, to Commanding General, Edgewood Arsenal, 10 July 1942, subject: Medical Research Division, Edgewood Arsenal, Md.

Permanent Organization

Chemical Warfare Service.—Reorganization was effected by the creation of the Medical Division, Chemical Warfare Service, the director of the Division being made directly responsible to the chief of that Service.[4] The research laboratory at Edgewood Arsenal, which had been controlled and financed but had not been operated previously by the Medical Department of the Army, was transferred to the Chemical Warfare Service and became an integral part of the new Medical Division. The Division was activated on 3 July 1943,[5] though the transfer of the laboratory to it was not effected until 15 July 1943.[6]

The newly created Medical Division had several missions, as follows:

1. Its medical mission was to carry out such research work as was necessary to develop adequate methods of treating injuries due to toxic and incendiary agents likely to be used in war.

2. Its toxicologic mission was to study the biologic effects of these agents and to develop adequate measures for the protection of troops against them.

3. Its liaison mission was twofold. First, it was to maintain such close contact with civilian laboratories, particularly with laboratories receiving financial support from the Office of Scientific Research and Development, as would make possible the utmost practical application of the work done in them in the fields of chemical warfare. Second, it was to keep The Surgeon General completely informed on all medical aspects of chemical warfare.

Office of the Surgeon General.—To permit the performance of the latter mission more effectively, the Chemical Warfare Branch was established in the Surgery Division, Professional Service, Office of the Surgeon General, on 12 August 1943, with Maj. (later Lt. Col.) Albert McG. Johnston as its head.[7] The functions of the Branch were (1) to maintain liaison with the Medical Division, Chemical Warfare Service, Army Service Forces, on matters pertaining to chemical warfare as related to the Medical Department of the Army, (2) to prepare information concerning, and directives for, the care of casualties caused by chemical warefare agents, and (3) to assist in the planning of field equipment used in the prevention and treatment of chemical warfare casualties.[8]

The new distribution of functions assigned to the Chemical Warfare Branch, Office of the Surgeon General, certain responsibilities which had here-

[4] Memorandum for file 29 Apr. 1943, subject: Proposed Medical Division for the Chemical Warfare Service Submitted by representatives of the Chief, Chemical Warfare Service, and The Surgeon General.

[5] Office Order No 48, Office of the Chief, Chemical Warfare Service, Army Service Forces, 3 July 1943

[6] Letter, D. C. Sapp, Adjutant General, Office of the Adjutant, Army Service Forces, to Commanding General, Chemical Warfare Center, Edgewood Arsenal, Md., The Surgeon General, and Chief, Chemical Warfare Service, 5 Aug. 1944, subject. Transfer of Medical Department Research Laboratory, Edgewood Arsenal, Md.

[7] (1) Office Order No. 572, Office of the Surgeon General, U.S. Army, 12 Aug. 1943. (2) Organization Chart, Office of the Surgeon General, U.S. Army, 3 Feb. 1944

[8] Manual of Organization and Standard Practices, Office of the Surgeon General, Army Service Forces, 15 Mar. 1944.



FIGURE 10.—Maj. George R. Greenwood, MC, Chief, Chemical Warfare Branch, Surgical Consultants Division, Professional Service, Office of the Surgeon General, and Consultant to The Surgeon General.

tofore belonged to the Chemical Warfare Service. One of the most important was the preparation of literature on first aid for, and on treatment of, gas casualties and on the detection of chemical agents in food and water. This branch was also assigned the provision of equipment to implement the procedures described. The literature issued and the equipment specified were based on recommendations made by the Medical Division, Chemical Warfare Service.

Major Johnston, the first consultant for the newly established Chemical Warfare Branch, was succeeded in March 1944 by Capt. (later Maj.) George R. Greenwood, MC, (fig. 10) who served until 17 September 1945, when the activities of this branch were suspended.

Policies.—The basic policy of the Chemical Warfare Branch was to keep fully abreast of all developments in this field which might eventually have some sort of impact on the Medical Department. In line with this policy, Major Greenwood usually paid three or four visits each week to the office of Col. Cornelius P. Rhoads, MC, Chief, Medical Division, Chemical Warfare Service, to discuss current problems relating to projects under way or to

secure information for articles to be prepared by the Medical Department dealing with first aid or other treatment for casualties of chemical warfare. The Medical Research Laboratory, Edgewood Arsenal, was also visited at least once a week.

These direct contacts and the intimate knowledge which was thus secured greatly expedited the solutions of many medical problems which otherwise might have temporarily floundered in administrative redtape after they had reached the Office of the Surgeon General. The cooperation received from Colonel Rhoads and from Colonel Wood, chief of the Medical Research Laboratory, Edgewood Arsenal, and later from Colonel Rhoads' successor, was always cordial and useful.

In the Office of the Surgeon General, Major Greenwood's chief contacts, outside of the Surgical Consultants Division, were with the Technical and Training Divisions, Operations Service, of that Office. The personnel of these divisions were also most cooperative. They offered technical help whenever it was necessary, and they willingly accepted recommendations on medical matters made by the Chemical Warfare Branch.

Major Greenwood also maintained close contact with research activities of civilian laboratories. He received reports from the National Research Council and the Office of Scientific Research and Development, and he attended the meetings at the University of Chicago, at Rockefeller Center, New York, N.Y., and in Washington, D.C. where the latest research developments were presented.

EQUIPMENT FOR PROTECTION AGAINST GAS WARFARE

Two important changes were made during World War II in equipment used for the protection and treatment of gas casualties. They had to do with the gas casualty set and the field oxygen equipment.

Gas Casualty Set

Reports from the Office of the Surgeon General, the Office of the Air Surgeon,[9] and the Surgeon, Army Ground Forces, [10] as well as verbal discussions with numerous medical officers during the first months of United States participation in World War II, indicated that the gas casualty set which was standard at the beginning of the war was undesirably heavy and unwieldy. A report from NATOUSA (North African Theater of Operations, U.S. Army) in 1943 stated that, because of their weight and bulk, these sets were not carried forward of the most rearward division medical units. Revision of the equip-

[9] Letter, Headquarters, Army Air Forces, Washington, D.C., to The Surgeon General, Washington, D.C., 26 Apr. 1943, subject: Gas Casualty Set.

[10] Letter, Maj. A. P. Thom, MC, Assistant Surgeon, Army Ground Forces, to Lt. Col. John R. Wood, MC, Director, Medical Research Laboratory, Edgewood Arsenal, 29 Apr. 1943.

ment to meet these objections was therefore recommended.[11] In response, a new, streamlined, light-weight gas casualty set (fig. 11) was developed by the Medical Research Laboratory, Edgewood Arsenal, and was standardized by the Army Service Forces on 9 May 1944. It was described in the July 1944 issue of the *Bulletin of the U.S. Army Medical Department.*

The new set weighed only 45 pounds, in contrast to the 160 pounds of the former gas casualty chest. It was made up of a gas casualty treatment kit and two inserts, each of which contained three impermeable aprons and three pairs of impermeable gloves. The basic unit (Kit, Treatment, Gas Casualty, Medical Department Item No. 97767) was an expendable item, resembling a small suitcase and weighing only 17 pounds. The contents of the kit were sufficient to care for the chemical casualties of one infantry battalion during 24 hours of active chemical warfare.

The new kit had other advantages in addition to its light weight. The rubber gasket lining the seam between the lid and body made it waterproof. Inside the lid was a graphic representation showing the exact location of each item of the contents. A booklet, entitled "Notes on Treatment of Casualties From Chemical Agents," was provided listing the symptoms, pathologic changes, and diagnostic points useful in the management of these injuries. All basic items were provided for the treatment of all varieties of gases likely to be encountered in modern chemical warfare.

The kit also included equipment for water testing with a book of directions. Small units were thus supplied with a simple device for screening out sources of water so contaminated with chemical agents that they could not be made potable by the usual methods of treatment in the field, such as chlorination in the Lyster bag.

Before the gas casualty treatment kit reached field units, however, a major change had to be made, which caused considerable consternation in the Technical Division, Operations Service, and in the Supply Service. All of the work on the kit, including its contents, had been carried out before March 1944, when Major Greenwood became chief of the Chemical Warfare Branch. Shortly after his arrival in the Surgical Consultants Division, he was summoned to the office of Col. (later Brig. Gen.) Fred W. Rankin, MC, Chief Surgical Consultant, to explain why a discrepancy existed between the policy of treating burns caused by chemical agents and that of treating those caused by more usual agents.

The gas casualty kit included a number of tubes of 5 percent sulfathiazole ointment, with instructions that the ointment be used in the treatment of both incendiary and vesicant burns. This policy, however, although it was in accordance with earlier instructions issued by the Office of the Surgeon General, had been changed because of certain toxic effects caused by the ab-

[11] Report, Capt. Louis Venet, MC, and 2d Lt. Matt J. Oehlberg, Chemical Warfare Service, undated, Report No. 14, Medical Research Laboratory, Edgewood Arsenal. A Gas Casualty Set for Medical Units.

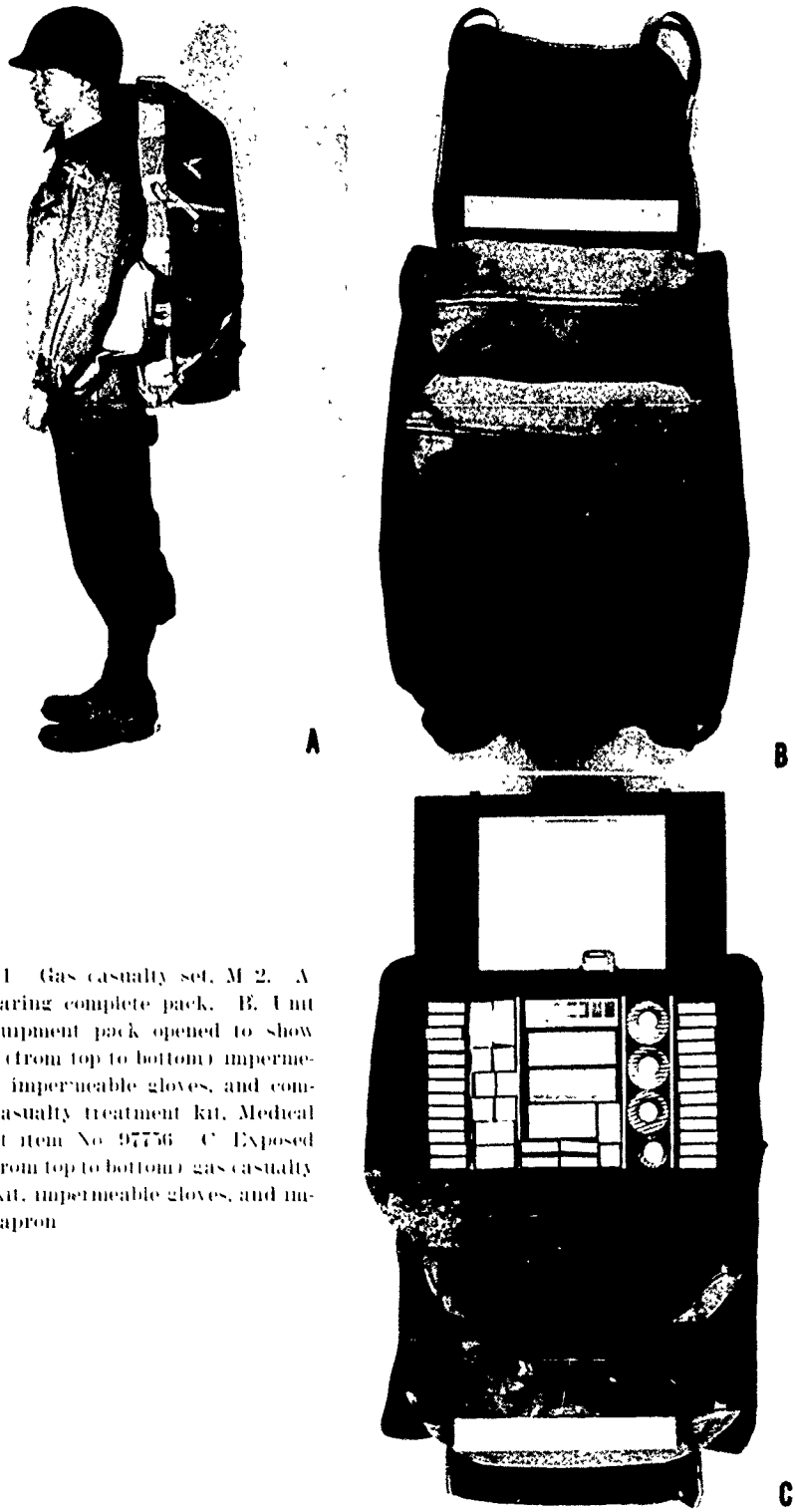


FIGURE 11.—Gas casualty set, M 2. A. Soldier wearing complete pack. B. Unit medical equipment pack opened to show packing of (from top to bottom) impermeable apron, impermeable gloves, and complete gas casualty treatment kit, Medical Department item No. 97756. C. Exposed contents (from top to bottom) gas casualty treatment kit, impermeable gloves, and impermeable apron.

sorption of sulfathiazole when it was used in burns involving large body surfaces. The current policy eliminated the ointment and directed the use of pressure dressings over petrolatum-impregnated dressings. There was no reason, as Colonel Rankin pointed out, why the same policy should not be used in the treatment of gas casualties, it being a well-established fact that burns sustained by vesicant agents did not differ from other burns in any respect, including therapy.

Major Greenwood, who had just come to the Chemical Warfare Branch in the Surgical Consultants Division from a field unit, could not explain why the changes in therapeutic policies had not been reflected in the components of the gas casualty treatment kits. Fortunately, although the kits had already been manufactured, they were still in warehouses and had not been distributed to field units, so petrolatum could be substituted for sulfathiazole ointment.

On Colonel Rankin's instructions, printing was also stopped on a revision of War Department Technical Manual (TM) 8-285, Treatment of Casualties From Chemical Agents, until the directions in the manual for the treatment of vesicant burns could also be altered.

Field Oxygen Equipment

In an effort to place in the field sufficient equipment for the treatment by oxygen of the large number of injuries due to lung irritants which might be expected in the event of gas warfare, the Army Service Forces, in March 1944, had standardized apparatus for the administration of oxygen (Oxygen Therapy Outfit, 20 Dual Outlet, with Hose Line Assembly, complete, Medical Department Item No. 9364200) (fig. 12). With this apparatus, a single source of oxygen could be used for the treatment of 20 gas casualties, each of whom would receive 8 liters of oxygen per minute, or for the treatment of 40 casualties, each of whom would receive 4 liters per minute.

Shortly after this item had been standardized, it became evident that the apparatus was inadequate to furnish 100 percent oxygen to the number of casualties it had been designed to treat.[12] A study of accidents at various chemical plants and of the casualties caused by the leakage of chlorine at the widely publicized accident in Brooklyn on 1 June 1944[13] made this quite clear. Reports from these sources showed that the average respiratory volume of gassed subjects was 10 to 12 liters per minute and that in some instances the volume ranged as high as 15 liters per minute.

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[12] (1) Letter, Director, Medical Research Laboratory, Edgewood Arsenal, to Chief, Medical Division, Office of Chief, Chemical Warfare Service, 16 June 1944, subject: Report of Test on Oxygen Therapy Outfit Hose Line Assembly, 20 Dual Outlets. (2) Letter, Chief, Medical Research Laboratory, Edgewood Arsenal, to Capt. George R. Greenwood, 23 June 1944, subject: Oxygen Requirements of Individuals With Lung Damage.

[13] Brooklyn Chlorine Accident, a Technical and Medical Report. Prepared for the Medical Division, Chemical Warfare Service, under contract W-49-036-cws-1 with New York University College of Medicine, 1 July 1944.

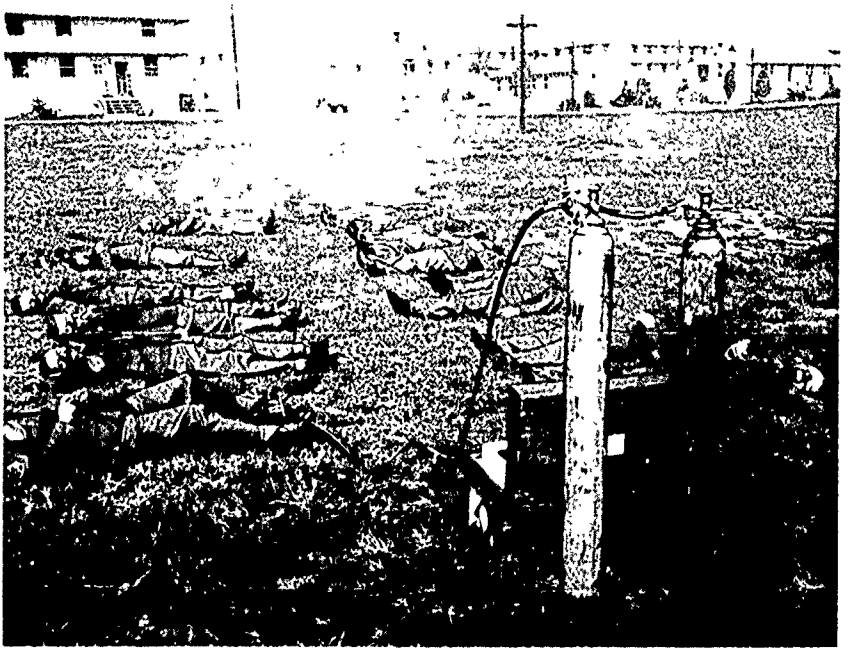


FIGURE 12. Demonstration of use of oxygen therapy outfit, 20 dual outlet, with hose assembly, at South Post, Fort Myer, Va., October 1944.

The recommendation of the Medical Division, Chemical Warfare Service,[14] that the equipment be modified to provide for an increase in the flow of oxygen, was concurred in by the Chemical Warfare Branch, Surgical Consultants Division, Professional Service, and was forwarded to the Technical Division, Operations Service, for appropriate action on 11 July 1944.[15]

It was fully realized, when the recommendation was made, that the increase in the rate of flow permitted by the new apparatus to overcome the deficiencies of the former apparatus would double the logistic and supply problem of the Army with respect to oxygen. The various theaters of operations were notified of the new developments and were offered sufficient supplies of cylinders for their probable needs. Some theaters at once requisitioned large additional supplies. At the same time, steps were taken to increase the number of cylinders allotted to units which had as part of their original equipment the apparatus which had proved inadequate.[16]

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[14] Letter, Chief, Medical Division, Chemical Warfare Service, to Office of the Surgeon General, attention: Capt. George R. Greenwood, 5 July 1944, subject: Further Tests of Oxygen Hose Line.

[15] Memorandum, Surgery Division, for Director, Technical Division, Office of the Surgeon General, 11 July 1944, subject: Oxygen Hose Line.

[16] (1) Memorandum, Capt. George R. Greenwood, Surgical Consultants Division, for Director, Technical Division, Office of the Surgeon General, 12 Dec. 1944, subject: Allowance of Oxygen Cylinders for Gas Team. (2) War Department Table of Organization and Equipment No. 8-126, 11 Nov. 1944.

While these developments were taking place, the possibility of the use of liquid oxygen was also being investigated, to determine whether it was practical to use it in the apparatus then standardized. If it could be used, a large volume of oxygen could be provided in a relatively small space, and the heavy, cumbersome oxygen cylinders currently in use could be dispensed with.

The project was dropped for two reasons. The first was that, contrary to the original belief, the supply of cylinders proved available for all purposes. The second was that liquid oxygen could not be used satisfactorily in equipment then on hand, which did not provide enough pressure for the desired rate of flow. An additional disadvantage was that from 3 to 4 percent of the volume of liquid oxygen was found to be lost during each 24 hours of storage.[17]

PROTECTION OF PERSONNEL AGAINST GAS

In World War I, the protection of Army personnel against chemical agents was the responsibility of the Medical Department until the organization of the Chemical Warfare Service in July 1918. In World War II, this task was always the responsibility of the Chemical Warfare Service. The Medical Department, however, was concerned in all aspects of the matter and frequently participated in conferences.

One of its deepest concerns was the provision of a gas mask which would adequately protect casualties who could not wear the regular Government-issue mask because of head injuries requiring bandages. After several conferences participated in by the Chemical Warfare Branch, the Development Branch (Technical Division, Office of the Surgeon General), and representatives of the Chemical Warfare Service, a model for this purpose was selected and was standardized after proper testing.

Certain shortcomings of this model were recognized when it was adopted. Since it covered the entire head and neck, heat and moisture tended to accumulate within it. Also, there was always a fairly large dead space within it, no matter how carefully it was applied. To meet these objections, the Chemical Warfare Service recommended on 5 December 1944[18] that a forced draft blower, to be connected to six masks and to serve as a collective protector, should be made part of the head wound gas mask equipment. The Chemical Warfare Branch approved the equipment in theory but suggested service testing.[19] When this had been carried out satisfactorily, the Office of the Surgeon General recommended that the equipment be standardized.

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[17] Report, Medical Research Laboratory, Edgewood Arsenal, to Chief, Medical Division, Chemical Warfare Service, 31 Oct. 1944, subject: Tests of Liquid Oxygen Vaporizer.

[18] Letter, Chief, Technical Division, Office of the Chief, Chemical Warfare Service, to Office of the Surgeon General, attention: Lt. Col. John B. Klopp, 5 Dec. 1944, subject: Head Wound Gas Mask.

[19] Letter, Chief, Technical Division, Office of the Chief, Chemical Warfare Service, to Office of the Surgeon General, attention: Lt. Col. John B. Klopp, 5 Dec. 1944, subject: Head Wound Gas Mask, indorsement thereto, dated 15 Dec. 1944.



FIGURE 13.—Fitting gas mask inserts (optical lenses) in the field, 69th General Hospital, Mediterranean theater, 1945.

Masking of helpless patients.— The Chemical Warfare Branch was actively interested in the application of gas masks to casualties who could not apply their own, either because they were unconscious or because they could not use their hands. A standard procedure for this purpose was obviously highly desirable, so that, in the event of gas warfare, masks could be expeditiously applied by hospital and other personnel to this group of casualties.

The procedure eventually recommended was suitable to the several types of gas masks (fig. 13) then in use (the light-weight service mask, with M-3 and M-4 facepieces, the combat mask, with M-5 facepiece, and the older service mask, with M2A1 or M2A2 facepiece). The technique was described, with illustrations, in War Department Technical Bulletin (TB MED) 169, issued in June 1945.

DETECTION OF CONTAMINATED FOOD AND WATER

At the beginning of United States participation in World War II, the Medical Department, although charged with the responsibility of determining the potability of water, did not possess suitable equipment for identifying possible contaminants in it. Two kits were eventually developed for this purpose by the Medical Research Laboratory, working in cooperation with the



FIGURE 14. M-4 water-testing kit—post-World War II Chemical Corps modification of the World War II water-testing kit. The World War II Medical Department kit was packed in a wooden box with fittings for all bottles containing liquids.

National Defense Research Committee. One kit (Kit, Water Testing, Screening, Medical Department Item No. 9931000), standardized on 9 July 1943, served as a qualitative screening kit. The other kit (Kit, Water Testing, Poisons, Treatment Control, Medical Department Item No. 99307) consisted of a large suitcase which contained apparatus and chemicals in sufficient quantities to perform quantitative analyses of contaminated water (fig. 14). Instructions for the use of these kits were published in War Department Technical Bulletin (TB MED) 37 on 28 April 1944 and were revised on 30

August 1944.[20] Copies of the original instructions and the revision were placed in each kit.

Although means for decontamination of food had long been known, no standard equipment was available to determine whether it was contaminated by the agents likely to be used in chemical warfare. It was therefore not possible to determine either the degree of contamination or the efficiency of the decontamination procedures until some means for this purpose had been devised. On 30 August 1944, the director of the Medical Research Laboratory forwarded to the Medical Division, Office of Chief, Chemical Warfare Service, a preliminary report on a kit for use in detecting chemical contaminants in dangerous amounts on food packages and in foods.[21] The use of a kit of this kind in the field would prevent the indiscriminate disposal of supposedly contaminated food supplies and would keep losses at a minimum in the event of gas warfare. The kit in question was approved by the Chemical Warfare Branch and was standardized by the Army Service Forces on 17 February 1945 (fig. 15). Various manufacturing difficulties, however, delayed progress, and hostilities ceased about the time that two manufacturers were ready to embark on full-scale production.

TRAINING LITERATURE AND FILMS

Publications

Numerous publications, in addition to those dealing with professional policies, served to disseminate training information concerning the medical aspects of chemical warfare. TM 8-285, Treatment of Casualties From Chemical Agents, first issued on 10 July 1941, was successively revised on 14 February 1942,[22] on 27 November 1942, on 15 April 1944, and in April 1945. Each revision brought up to date the changes in therapeutic policies developed in the Office of the Surgeon General as new information became available. In the last revision, two appendixes were added. One appendix, well illustrated with photographs, dealt with the disposition of personnel with blister gas burns. The other dealt with general principles in the handling of patients contaminated by chemical agents.

The *Bulletin of the U.S. Army Medical Department* was utilized to provide for medical officers short, concise reviews of the treatment of mustard

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[20] War Department Technical Bulletin (TB MED) 169, Changes 1, 30 Aug. 1944.

[21] Letter, Director Medical Research Laboratory to Chief, Medical Division, Office of Chief, Chemical Warfare Service, 30 Aug. 1944, subject: Kit for the Detection of Contaminating Chemical Warfare Agents on Foods and Food Packaging Materials, with inclosure, dated 26 August 1944.

[22] War Department Technical Manual (TM) 8-285, Changes No. 1, 14 Feb. 1942.

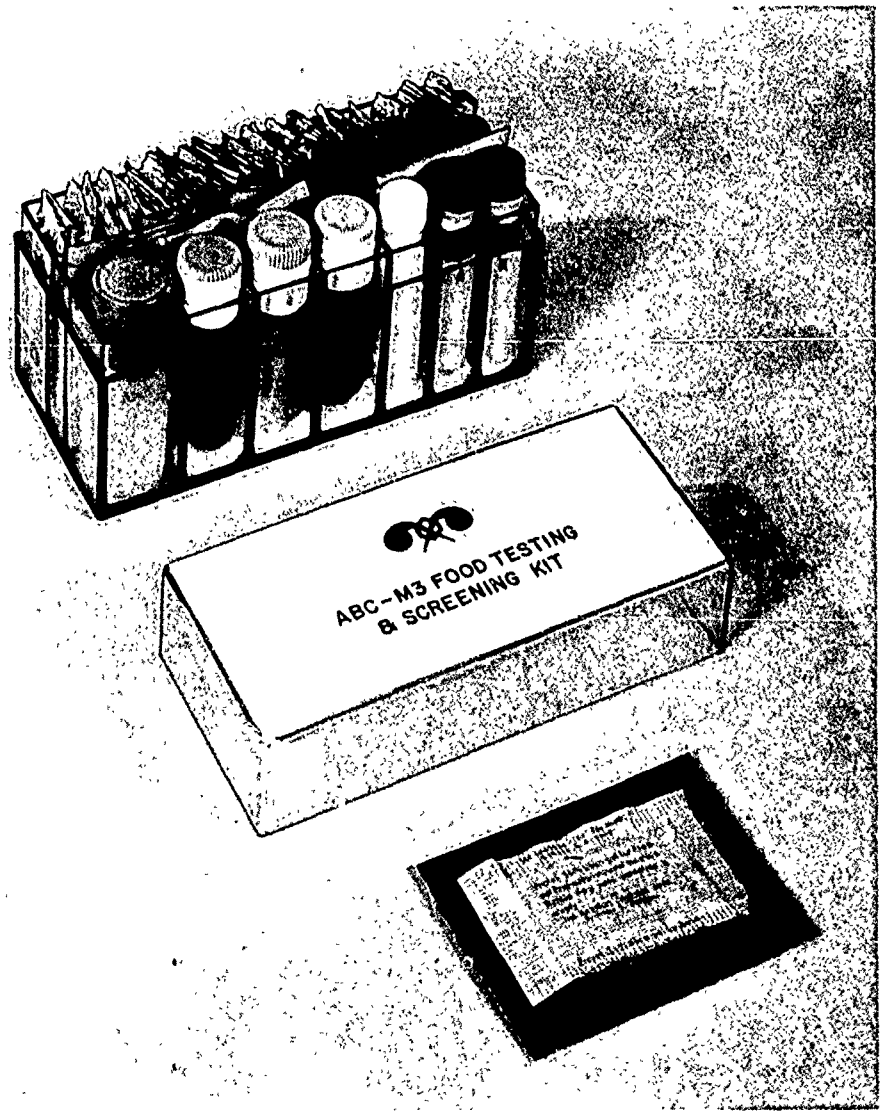


FIGURE 15 Food testing and screening kit, a post-World War II Chemical Corps modification of the World War II Medical Department kit.

burns,[1] lung irritations,[2] and burns of the eye.[3] Information was also presented in this bulletin concerning exposure to chlorine[4] and concerning pulmonary damage caused by FS (sulfur trioxide-chlorosulfonic acid) smoke.[5]

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[1] Prevention and Treatment of Mustard Burns. Bull U S Army M Dept SO 1, September 1944.
[2] Treatment of Casualties Due to Lung Irritants. Bull U S Army M Dept SI 3-4, October 1944.
[3] Infected Chemical Burns of the Eye. Bull U S Army M Dept SI 8, December 1944.
[4] Chemical Study of Exposure to Chlorine. Bull U S Army M Dept SO 2, September 1944.
[5] Pulmonary Damage Caused by FS Smoke. Bull U S Army M Dept SI 6, January 1945.

Films

In 1943, following a number of changes in policy concerning first aid to chemical warfare casualties, the existing training film on this subject was declared obsolete and was replaced by a new film, TF 8–1180, First Aid for Chemical Casualties. Additional changes in first aid policies were made the following year, and in December 1944 it was brought to the attention of the chief of the Medical Division, Chemical Warfare Service, that the 1943 film was outdated in several important respects.[28] In February 1945, a representative of the Navy informally approached the Training Division, Office of the Surgeon General, with the suggestion that a joint Army-Navy film be prepared on the subject.

Certain differences in policy between the two Services had to be reckoned with before this could be accomplished. The Navy procedure for decontamination of liquid blister gas on the skin differed from the Army procedure, and the ointments issued by the two Services were different. It was believed that these differences could readily be overcome in the film. When the lecture upon which the scenario was to be based was prepared, however, it became clear that there would be considerable difficulty in presenting both decontamination procedures in the same film.

It was believed then that this obstacle could be overcome by filming two separate versions of the procedure and issuing the appropriate version of the film to each branch of the Services.[29] Army Service Forces headquarters however, when this idea was presented, ruled that under the circumstances the film could no longer be classified as a joint Army-Navy project.[30]

The original plan, therefore, was amended to provide the Navy with a copy of the Army film, into which a sequence, presenting the Navy decontamination procedure and shot separately, could be spliced.

The lecture containing the technical information was then sent to the Signal Corps. Their writers, stationed in the Eastern Division studios of the Army Pictorial Service at Astoria, Long Island, N.Y., prepared the scenario. When the first effort of these writers was reviewed by the chief of the Chemical Warfare Branch, who had been selected to serve as technical adviser for the film, it was found that they had overemphasized the horrors of chemical warfare. This was an important item contrary to present policy, and the scenario therefore had to be rewritten.

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[28] Memorandum for the record, Medical Division, Chemical Warfare Service, 27 Feb. 1945, subject: Training Film on First Aid for Gas Casualties Due to Chemical Agents.

[29] Memorandum, Chief, Chemical Warfare Branch, Surgical Consultants Division, for Director, Training Division, attention: Colonel Ainlay, 2 May 1945, subject: Training Film on First Aid for Gas Casualties.

[30] (1) Memorandum, Brig. Gen. R. W. Bliss, Chief, Operations Service, for The Commanding General, Army Service Forces, attention: Director, Training Requirements Division, 27 Mar. 1945, subject: Request for Training Film, second indorsement thereto, dated 8 May 1945. (2) Letter, Director, Military Training, Army Service Forces, to Chief, Bureau Medicine and Surgery, Navy Department. 23 May 1945, subject: Training Film on "First Aid for Gas Casualties."

After several more consultations with the writers at both Astoria and Washington, an acceptable scenario was prepared.[31]

The Signal Corps decided that their Western Division studio in Hollywood, Calif., would be the scene of the filming. Production was about to begin when hostilities ended on 14 August 1945, and the whole project was canceled.

In view of the changes in policy concerning treatment of gas casualties, the Chemical Warfare Branch recommended to the Training Division, Office of the Surgeon General, in April 1945, that the Filmstrip FS 8–80, The First Aid Kit for "Gas Casualties," be declared obsolete. It was decided that this strip should be replaced by a strip dealing with first aid as the individual soldier was taught to practice it. Frame descriptions had been submitted to Carlisle Barracks for sketching when hostilities ended.

PROFESSIONAL POLICIES IN WORLD WAR II

Although toxic gases were never employed against U.S. troops in World War II, it was necessary to be as fully prepared against them from the medical standpoint as from the military standpoint. To teach the soldier to protect himself against them, and to teach him first aid in the event of their use, it was necessary to demonstrate the action of certain gases.

Tear gas, a favorite chemical agent for training purposes, made the soldier proficient in the use of the gas mask. Other gases, such as phosgene, lewisite, and mustard, were also used in dilute quantities to acquaint the soldier with the odors of various toxic agents. In the medical officers' courses at the Chemical Warfare School, Chemical Warfare Center, Edgewood Arsenal, Md., trainees saw the effect of mustard on their own skin when it was applied in a small quantity. Furthermore, they saw the effects of many of the gases on experimental animals.

The most massive exposure of Allied troops to gas occurred at Bari, Italy,[32] when enemy bombing resulted in the release of a large quantity of mustard gas which was in one f the Allied ships in the harbor. Many casualties resulted. Informative reports on the pathologic processes in these casualties were forwarded to the Medical Division, Chemical Warfare Service, by the Chief Medical Gas Officer, NATOUSA.

In anticipation of possible gas warfare on some of the jungle islands of the Southwest Pacific, the Chemical Warfare Service had established an experimental station on a previously uninhabitable tropical island in the Archipiélago de las Perlas in the Gulf of Panama. The aims were to determine the feasibility of carrying on offensive gas warfare in a jungle climate and to learn if Army protective equipment would be efficient in its primary purpose while it

[31] Memorandum, Chief, Chemical Warfare Branch, Surgical Consultants Division, for Director, Training Division, attention: Lt. Col. R. J. Moorehead, 23 July 1945, subject: Comments on Training Film, First Aid or Self Aid in Chemical Warfare.

[32] Report, Lt. Col. Stewart F. Alexander, MC, Consultant, Chemical Warfare Medicine, Office of the Surgeon, NATOUSA, to Director, Medical Service, Allied Force Headquarters, and to the Surgeon, NATOUSA, 27 Dec. 1943, subject: Toxic Gas Burns Sustained in the Bari Harbor Catastrophe.

still permitted troops to carry on their normal, every day and night living and duties.

One of the largest of the field tests was conducted on this island in August 1945. Two companies of volunteer troops from the Canal Zone maneuvered for 24 hours in an area on the island which had previously been bombed with mustard from B–24 bombers. The troops were fully protected with standard protection equipment. The area was bombed in a concentration of 180 tons per square mile, far greater than any field of battle concentration experienced in World War I. The chief of the Chemical Warfare Branch and several other medical officers from the Army and Navy, whose primary military interests lay in the field of chemical warfare, were invited to attend this test as observers.

At the end of the 24-hour period, the troops engaged in the test were all thoroughly examined by medical officers. There was not one casualty. There was no opportunity to see any first aid executed, but it was comforting to know that Army protective equipment was so efficient.

First aid.—The teaching of first aid in chemical warfare was extremely difficult. Most chemical agents required separate rituals, and it was necessary for the soldier to be able to distinguish between different gases at a time when circumstances would make the differentiation difficult if not impossible. Instruction on these matters during the war was gradually made as simple as possible, with the idea that if the soldier did not bear in mind all the details he had been taught at least he would remember certain essential points.

CLASSIFICATION OF CHEMICAL AGENTS

For medical purposes, the most useful classification proposed for agents of chemical warfare segregated them according to their primary physiologic action. On the other hand, such a classification, while satisfactory from this standpoint, made no allowance for the secondary effects of which many of these agents were capable, nor did it include either the incendiaries (white phosphorus, magnesium and its alloys, thermites, and oils) or the screening smokes (HC (hexachloroethane) mixture, titanium tetrachloride, and sulfur-trioxide-chlorosulfonic acid solution).

On the basis of their physiologic action, toxic chemical agents used in warfare were classified as follows:

1. Vesicants (blister gases), which included mustard, nitrogen mustard, lewisite, ethyldichlorarsine, and phenyldichlorarsine.

2. Lung irritants (choking gases), which included phosgene, chloropicrin, and chlorine.

3. Sternutators (vomiting gases), which included diphenylaminechlorarsine, diphenylchlorarsine, and diphenylcyanarsine.

4. Systemic poisons (blood and nerve poisons), which included hydrocyanic acid, cyanogen chloride, and arsine.

5. Lacrimators (tear gases), which included chloracetophenone, chloracetophenone solutions, and brombenzylcyanide.

Two of the gases in this list, the nitrogen mustards and cyanogen chloride, were first described in the course of World War II. Information concerning the nitrogen mustards was released in War Department Training Circular No. 86 on 13 November 1942, and information concerning cyanogen chloride was released in April 1944.

Vesicants

Evolution of policies

The treatment of mustard burns varied considerably in the course of the war, as the various editions of TM 8-285 show. In the July 1941 version, tannic acid and silver nitrate were recommended for local use. In the November 1942 version, amyl salicylate and sulfadiazine ointment were recommended for the same purpose. In the April 1944 version, the use of these agents was prohibited, only mild ointments were advised, and the use of local pressure dressings with petrolatum jelly was the treatment of choice.

One of the most notable advances made during World War II in the field of chemical warfare was the discovery of the compound known as BAL (British Antilewisite). Its value as a specific in first aid and in the later treatment of casualties caused by lewisite and other arsenical vesicants was first recognized in 1941,[33] but it was not until 1943 that the Medical Division, Chemical Warfare Service, recommended that BAL eye ointment be standardized.[34] This was accomplished on 8 July 1943, and 3-gm. ophthalmic tubes were prepared for individual issue.

The value of BAL ointment in decontamination of the skin after lewisite contamination was not questioned. It was considered to be more judicious, however, rather than to encumber the soldier with another tube of ointment for the skin and thus complicate first aid measures further, to continue the use of M-5 protective ointment (which was used primarily for mustard contamination) for the arsenical vesicants also, since it was fairly effective against the latter chemical agents. In September 1943, BAL ointment, in ¾-ounce tubes, was approved for issue in Kit, First Aid, Gas Casualty, (fig. 16) and Kit, Treatment, Gas Casualty.

By the close of the war, in an effort to standardize first aid procedures when the eyes were contaminated by any liquid gas, the application of BAL eye ointment, followed by massage and irrigation, was recommended for all contamination of the eyes by liquid vesicants.[35] In 1941, irrigation alone had

[33] Medical Department (Edgewood Arsenal) Memorandum Report 39. C. B. Marquand, O. E. McElroy, and T. W. Kethley, 15 Dec. 1941, subject: The Use of Beta-Gamma-Dimercapto-Propyl-Alcohol (DTH) in the First-Aid Treatment of Liquid Lewisite Burns.

[34] Medical Department (Edgewood Arsenal) Memorandum Report 88, F. Dickson Brown and B. P. McNamara, 1 May 1943, subject: The Effectiveness of Self Eye Medication During Pain and Blepharospasm.

[35] (1) War Department Technical Bulletin (TB MED) 153, First Aid for Liquid Blister Gas Contamination of the Eye, March 1945. (2) Liquid Vesicant Contamination of the Eyes. Bull. U.S. Army M. Dept. 86: 30-31, March 1945.

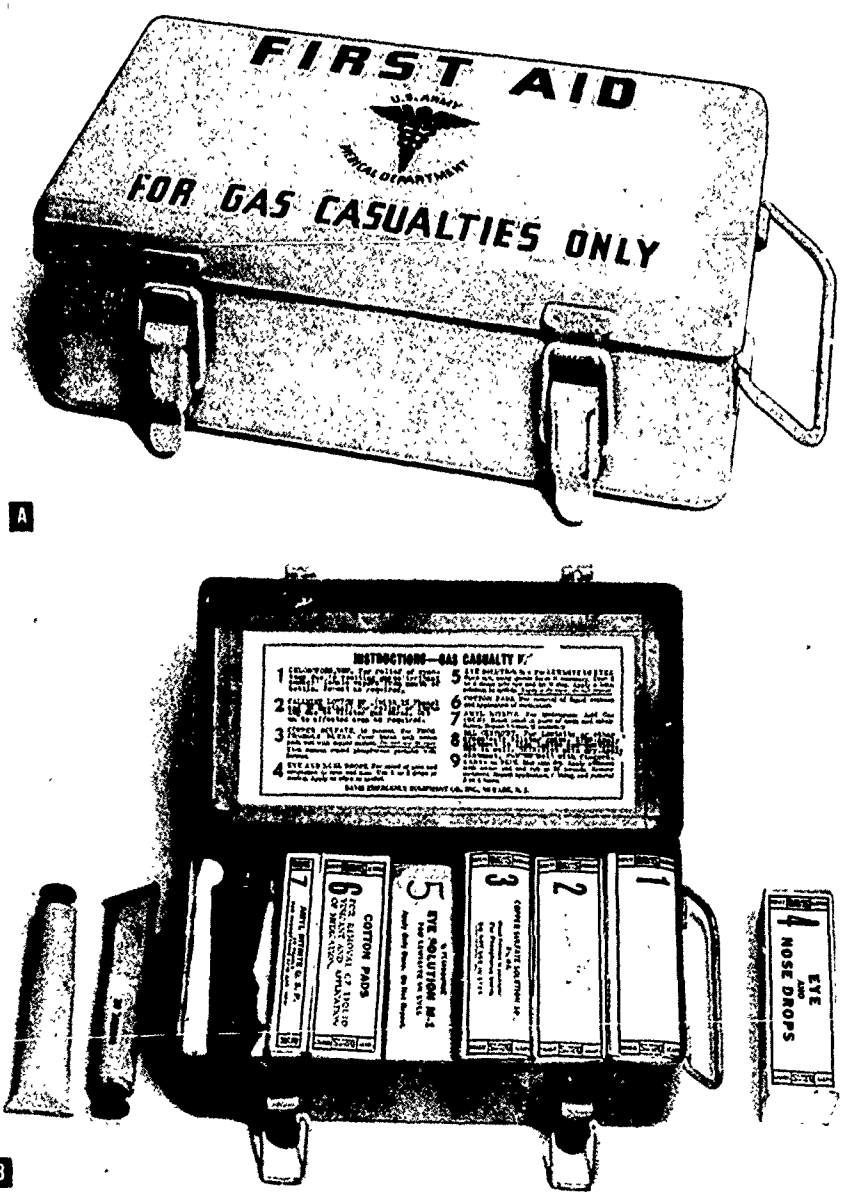


FIGURE 16 Complete first aid gas casualty kit. Medical Department item No. 9776400. A. Container for kit. B. Packing of contents. Eye and nose drops carton and BAL ointment tubes removed to show packing of eye solution and protective ointment on bottom level.

been recommended for mustard contamination. Lewisite contamination was not mentioned in the first edition of War Department Technical Manual 8-285, which was published in that year. In 1942, the application of eye ointment M-1 was recommended for lewisite. In 1944, BAL eye solution M-1 was recommended for lewisite contamination, and in 1945 this preparation was recommended for mustard contamination also.

For many years, it had been believed that the fluid in blisters caused by lewisite was both vesicant and toxic, and, on this basis, aspiration of the blisters was advised, to prevent the possibility of arsenic poisoning. A thorough investigation of the subject during the war permitted the statement in 1944 that, although the fluid does contain a trace of arsenic, it is neither vesicant nor toxic and aspiration is therefore not necessary.[36]

With the discovery of the effectiveness of BAL in decontamination of the eye and skin after contamination with lewisite and other arsenical blister gases, much effort was expended in an endeavor to determine its effectiveness in the treatment of systemic poisoning caused by these agents. Because of BAL's ready absorption by the skin, it was recommended in 1944 that this compound be used as an inunction under these circumstances. BAL in oil, which had been studied for a considerable time for possible systemic use, was standardized by the Army Service Forces on 22 May 1944, and information concerning it was disseminated in War Department Technical Bulletin (TB MED) 101, Use of BAL in Oil and BAL Ointment in Treatment of Systemic Poisoning Caused by Lewisite and Other Arsenical Blister Gases, dated 4 October 1944, and also in the November 1944 issue of the *Bulletin of the U.S. Army Medical Department.*

Final policies and practices

At the close of the war, the following data and instructions concerning poisoning by vesicants, as detailed in TM 8-285, April 1945, represented the current therapeutic practices in the U.S. Army Medical Department:

Vesicants as a group act primarily on the eyes and skin. When inhaled, they cause injury to the respiratory tract. When absorbed, they cause systemic poisoning.

Mustard. The eyes are more vulnerable to mustard than is any other part of the body. Symptoms do not immediately follow exposure, and the latent period varies from 1 or 2 hours to 12 hours, depending upon the degree of exposure. Resulting lesions vary from mild conjunctivitis to severe injuries of the cornea with opacification, ulceration, and vascularization.

If the eyes have been exposed to mustard vapor only, no decontamination procedure is of any value. When contamination involves liquid gas, however, first aid procedures employed within 2 minutes will be of value. BAL ointment should be squeezed directly into the lower conjunctival sac, after which the eye should be massaged for 1 minute and then irrigated for from 30 seconds

[36] War Department Technical Manual (TM) 8-285. 15 Apr. 1944.

to 2 minutes. The application of ointment, even if previous symptoms are lacking, is followed by pain and blepharospasm, but the pain will be relieved or entirely controlled by irrigations.

Mild conjunctivitis is treated symptomatically. Sulfacetimide (Sulamyd) sodium solution (2 drops) in 3 percent solution is instilled every 4 to 8 hours to prevent infection. In more severe cases, with edema of the lids, photophobia, blepharospasm, and other obstruction of vision, pain is likely to be persistent and morphine or other systemic sedation must be used to control it. Mydriasis should be effected by the use of atropine in 1 percent solution.

Infection can be prevented by the instillation of a few drops of Sulamyd sodium in 3 to 10 percent solution every 4 hours, or by the use of penicillin (1,000 units per 100 cc.) or of sulfathiazole ophthalmic ointment. Secretions can be removed by gentle irrigations with isotonic saline solution. Established infections should be treated by the instillation of Sulamyd sodium in 10 percent solution every 2 hours, or by the local use of penicillin or of sulfathiazole ophthalmic ointment every 4 hours.

No immediate symptoms follow the exposure of the skin to mustard vapor or liquid, but at the end of a latent period lasting from 1 to 12 hours erythema develops, with itching and some burning, followed by vesication in all but mild exposures. Liquid mustard on the skin requires prompt decontamination. The excess liquid should be blotted off, M–5 protective ointment applied freely, the excess wiped off, and additional ointment applied and allowed to remain until it can be washed off with soap and water. Erythema should be treated symptomatically. Blistered and denuded areas should be treated by the application of sterile petrolatum and covered by sterile pressure dressings. A sterile technique is essential, and frequent changes of dressing should be avoided.

Specific antibacterial therapy should be employed according to the indications. Penicillin, which is the drug of choice, should be given intramuscularly in doses of 25,000 units every 3 hours as long as indicated.

Symptoms following the inhalation of mustard vapor come on slowly. They begin with hoarseness and possibly aphonia and progress to cough, fever, and dyspnea. Lesions range from mild hyperemia of the laryngeal and tracheobronchial mucosa to congestion of the pulmonary parenchyma, with mild patchy edema, emphysema, and focal atelectasis. Bronchopneumonia is a frequent complication.

Cough and irritation should be treated symptomatically. Bronchitis should be treated with steam inhalations. When clinical evidence of severe respiratory tract injury exists, penicillin should be given prophylactically, in the hope of preventing bronchopneumonia. Should pneumonia develop, the usual treatment for it should be employed.

Absorption of mustard through the skin or the ingestion of mustard-contaminated food or water may cause severe gastrointestinal disturbances associated with pain, nausea and vomiting, diarrhea, and sometimes fever and

prostration. When the quantity absorbed approaches the lethal dose, the hematopoietic tissue may be damaged, as evidenced by leukopenia and thrombocytopenia in the peripheral blood.

Treatment consists of infusions as indicated to maintain the fluid and electrolyte balance; barbiturates to control restlessness and discomfort; and morphine, if necessary, to reduce gastrointestinal activity.

Nitrogen mustards.—The eyes are affected more quickly by nitrogen mustards than by mustard, though not as quickly as by lewisite. The lesions are, in general, similar to those caused by mustard, but the symptoms may be more severe, and local necrosis of the cornea may terminate in rupture of the globe. Decontamination and treatment are carried out as described under the heading of mustard. The same holds for the management of skin lesions and lesions of the respiratory tract.

The most pronounced effects of the absorption of nitrogen mustards through the skin or the respiratory or gastrointestinal tracts are on hematopoietic tissue and lymphoid tissue. Degenerative changes in bone marrow may be followed by involution of the thymus, spleen, and lymph nodes, with resulting lymphopenia, granulocytopenia, thrombocytopenia, and anemia. If vomiting and diarrhea occur, as they frequently do, they should be treated by transfusions of whole blood and the use of other parenteral fluids as indicated.

Lewisite.—Liquid lewisite is extremely damaging to the eyes. Pain and blepharospasm occur immediately following exposure, and there is immediate searing of the cornea, with edema and closure of the eye within an hour. The degree of corneal injury depends upon the degree of exposure. Healing may occur without permanent defects, but the more severe exposures are likely to terminate in pannus formation or massive necrosis.

Decontamination and therapy should be carried out as for mustard. In contrast to its effect in mustard poisoning, however, BAL ointment immediately relieves pain and blepharospasm caused by lewisite. If it is used within 1 minute of exposure, healing usually occurs without permanent damage. If it is used within 10 minutes, healing will occur, but there will be some residual effects. Used after 30 minutes, the ointment is of no value.

Contact of liquid lewisite with the skin produces, within a few seconds, a stinging pain, which quickly increases in severity. The pain is followed within about 30 minutes by erythema and within about 12 hours by vesication. Tissue damage is in general more severe than that caused by mustard.

Ideally, lewisite can be decontaminated by BAL ointment, which is spread on the skin in a thin film, rubbed in, and allowed to remain for a minimum of 5 minutes. By this method of application, any lewisite which has been absorbed is neutralized, as is the lewisite on the skin. The reasons for not using it, however, have already been set forth (p. 84). Treatment of lewisite poisoning is similar to that for poisoning by mustard.

Inhaled lewisite vapor is extremely irritating to the respiratory tract and causes lesions similar to those caused by mustard. Therapy is a combination

of the treatment recommended for mustard injuries of the respiratory tract and the treatment recommended for systemic arsenical poisoning.

Systemic poisoning with lewisite may result from its absorption from skin contamination or from absorption of vapor from the respiratory tract. Loss of fluid from damaged capillaries may be severe enough to cause hemoconcentration, shock, and death. Focal necrosis of the liver may be the result of oxidized products and lewisite, and pulmonary edema may follow direct inhalation of the vapor as well as absorption from the skin.

Therapy directed toward systemic lewisite poisoning is indicated in the presence of any of the following manifestations:

1. Any evidence of pulmonary edema, such as a cough with dyspnea and frothy sputum.

2. Any skin burn the size of the hand, or larger, if decontamination has not been effected within 15 minutes of exposure; skin contamination of 5 percent of the body surface if evidence of skin damage has appeared within 30 minutes of exposure; and blisters the size of the hand or larger.

When lewisite has been absorbed through the skin, BAL ointment should be rubbed into the affected areas and permitted to remain. BAL in oil (10 percent solution) should be given intramuscularly into the buttocks, the dosage being adjusted to the estimated body weight (2.5 cc. for 125 pounds, 3.0 cc. for 150 pounds, 3.5 cc. for 175 pounds, 4.0 cc. for 200 pounds). Four doses are given at 4-hour intervals, though in severe cases the interval between the first and second dose is shortened to 2 hours. A single daily dose in half the original amount is then given for 3 or 4 days.

A wide variety of symptoms and signs may occur from 15 to 30 minutes after the injection of BAL in oil. The most serious of these is a transient rise in blood pressure. Reactions may last 30 minutes, but, unless they are prolonged or unduly severe, the full course of treatment should not be interrupted.

Ethyldichlorarsine and phenyldichlorarsine.—The lesions and symptoms caused by these agents are similar to those described for lewisite, and the same treatment is required.

Lung Irritants

Evolution of policies

The treatment and disposition of personnel exposed to lung irritant gases, as prescribed in succeeding issues of TM 8-285, Treatment of Casualties From Chemical Agents, underwent three definite modifications during the course of the war.

In the 1941 edition of the manual, prompt, absolute rest was advocated, even in the latent stage. The administration of morphine was forbidden, even though the patient might be restless and apprehensive. Venesection was advocated as probably the best available therapy for phosgene poisoning during the cyanotic stage.

In the 1942 revision, it was left to the discretion of the commanding officer of the battalion, with the advice of the surgeon, to determine whether or not a soldier who had been subjected to lung-irritant gas should continue in combat, due account being taken of the possible risk of pulmonary edema.

In the 1944 revision, the definite policy was adopted that men might continue at their duties pending the appearance of clear-cut symptoms. In the same year, it was recommended that morphine be given whenever the administration of oxygen failed to quiet the patient. Venesection was no longer advocated, on the ground that it undoubtedly did harm during the shocklike stage and was of doubtful value at any time.

Final policies and practices

At the close of the war, the following data concerning the effects and treatment of lung irritants, as prescribed in TM 8-285, April 1945, represented current U.S. Army medical policy.

Of the important lung irritants, phosgene produces its primary effects on the pulmonary parenchyma, while chloropicrin and chlorine are more likely to injure the trachea and bronchi.

Phosgene.—Initial damage to the capillaries of the pulmonary parenchyma after the inhalation of phosgene is followed by loss of fluid from the capillaries and by early, massive, pulmonary edema. Loss of plasma into the alveoli results in hemoconcentration. Pulmonary edema reaches its maximum 12 to 14 hours after exposure, and gaseous exchange in the lung is inhibited. Death from anoxemia may occur within from 24 to 48 hours. In cases which go on to recovery, edema begins to subside at the end of 48 hours. To prevent secondary bronchopneumonia, which may develop from 3 to 5 days after exposure, specific antibacterial therapy, preferably penicillin, may be given prophylactically when edema begins to subside.

The early symptoms of phosgene poisoning, which include coughing, choking, or vomiting, are not a prognostic yardstick. In some cases, a latent period of from 2 to 24 hours is followed by signs of pulmonary edema, of which cyanosis is the most ominous. The condition may become steadily progressive, and the patient eventually passes into a shocklike state. If signs and symptoms of respiratory distress appear in a person who has been exposed to phosgene and has continued with his duties, he must be put at complete rest immediately, kept comfortably warm, and given oxygen in as high concentration as possible. If distress continues, morphine may be given cautiously, in small doses. Codeine is useful if cough is the most prominent symptom.

Drugs tested and proved useless or even harmful in the treatment of phosgene poisoning include atropine and cardiac and respiratory stimulants such as epinephrine (Adrenalin), ephedrine, amphetamine (Benzedrine) sulfate, nikethamide (Coramine), pentylenetetrazol (Metrazol), and alcohol. Plasma and parenteral fluids are not useful. Venesection is also not useful and is definitely harmful if practiced during the shocklike stage.

Chloropicrin.—The effects of this agent are essentially the same as those of phosgene, except that chloropicrin is quite irritating to the eyes and more destructive to the bronchiolar epithelium. Symptomatic treatment is sufficient if the ocular injury is mild. Otherwise, therapy is the same as for phosgene.

Chlorine.—The immediate symptoms of chlorine poisoning, which include burning in the throat, coughing, and a sense of suffocation, are the result of injury to the upper respiratory tract. The gas is extremely irritating to the entire respiratory tract. Therapy is the same as for phosgene poisoning.

Sternutators

Measures against sternutators, the effect of which, while temporarily incapacitating, is transient, underwent only one change during the course of the war. The original treatment was to inhale the vapors from a bottle containing bleach powder. Later, chloroform vapor was substituted.

Sternutators are dispersed by heat in the form of smoke. The medical effect of all three gases in the group is similar. They irritate the nose, sinuses, throat, and eyes. Symptoms include pain and a sense of fulness in the nose, headache, a sensation of burning in the throat, a sense of tightness in the chest, very severe coughing and sneezing, lacrimation, frequently nausea and vomiting, and sometimes mental depression.

Except during the act of vomiting, the gas mask should be worn during exposure to these agents. The inhalation of chloroform may give considerable relief, but, whether it is used or not, prompt recovery is the rule in all cases.

Systemic Poisons

Evolution of policies

The treatment of cyanide poisoning by amyl nitrite was considerably modified in the course of the war. In the July 1941 edition of TM 8-285, it was recommended that amyl nitrite fumes be inhaled for 15 to 30 seconds every 3 minutes until sodium thiosulfate could be given intravenously. In the November 1942 revision, it was recommended that the number of ampules used in a given case be reduced to four, and, in the April 1944 revision, the number was reduced to two. However, since the purpose of the medication is to form methemoglobin and since a greater concentration than could be produced by these dosages was desirable, the April 1945 revision of the manual recommended that a total of eight ampules be given in four doses of two ampules each. This amount is adequate to combat the effects of the cyanide gases, and the vasodepression which follows its use is not dangerous.

With this exception, no serious modifications in the therapy of systemic poisons were made during the course of the war.

Final policies and practices

Hydrocyanic acid.—This agent produces its effects by combination with an enzyme essential for oxidation within the tissues. The respiratory center is particularly susceptible. Exposure to high concentrations of the gas results, within a few seconds, in an increased depth of respiration, followed within 20 to 30 seconds by convulsions and within 60 seconds by cessation of respiration. The heart continues to beat for several minutes longer.

As soon as the gas mask is applied, two ampules of amyl nitrite are crushed and placed beneath the facepiece. The procedure is repeated every 3 or 4 minutes until eight ampules have been given. The nitrite immediately forms methemoglobin, which competes with the enzyme in taking up the cyanide. When it is available (it was an item in short supply during World War II), sodium nitrite (10 cc. of 1 percent solution) should be injected intravenously over a period of 1 minute at 10-minute intervals until a total of 50 cc. has been given. Each injection of sodium nitrite is alternated with the injection by vein of 10 cc. of 10-percent sodium thiosulfate solution. Artificial respiration should be attempted if respiration ceases.

Cyanogen chloride.—The immediate action of this agent is similar to that of hydrocyanic acid, but it also acts on the respiratory tract as phosgene does. Treatment is similar to that prescribed for hydrocyanic acid and phosgene.

Arsine.—After arsine is absorbed from the respiratory tract, its first effect is to produce hemolysis, evidenced by anemia, hemoglobinemia, methemoglobinemia, and hemoglobinuria. It also affects the liver and kidneys by way of its presence in the circulating blood. Death results from anemia or from hepatic or renal failure.

Treatment consists of intravenous fluids, blood transfusions as indicated, and injections of BAL in oil as in the treatment of systemic lewisite poisoning.

Lacrimators

No change was made in the treatment of contact with lacrimators in the course of the war. All gases in this group cause immediate pain, blepharospasm, and lacrimation, and they also irritate the skin and nose.

The most effective first aid measure is immediate masking. The eyes must not be rubbed; if they contain liquid contaminant, they should be washed out with water. Superficial skin burns should be treated symptomatically. A 0.25-percent solution of sodium sulfite neutralizes these agents.

CHEMICAL BURNS

White phosphorus ignites spontaneously when it is exposed to air, and if the flaming particles hit the skin they are always difficult to remove. Copper sulfate in 5 percent solution was recommended as a first aid measure. The

flame could be extinguished and the particles could be kept from reigniting by repeated applications of water until the copper solution could be applied.

The usefulness of copper sulfate is twofold. It coats phosphorus particles with copper phosphide, so that they do not reignite on exposure to air, and it makes them visible in the burned areas of the skin, with the result that they are more readily removed.[37]

Early in 1944, reports from ETOUSA (European Theater of Operations, U.S. Army)[38] suggested that gauze or double-napped cotton flannel impregnated with copper sulfate would be useful in the equipment of the individual soldier, since wetting the pad with water from his canteen would immediately provide copper sulfate solution. On requisition from this theater, an issue of nonstandard double-napped flannel pads, 3 by 3 inches, impregnated with copper sulfate and packed three to an envelope, was approved. After thorough investigation, standardization of the item was accomplished on 5 February 1945.[39] The pad was described in the July 1945 issue of the *Bulletin of the U.S. Army Medical Department.*

Reports from the Southwest Pacific in 1945 were to the effect that casualties caused by white phosphorus were steadily increasing in number and that some patients had developed what was believed to be systemic phosphorus poisoning. Medical officers in the field reported difficulty in securing information on the subject, which was not surprising in view of the paucity of material in the literature. Because of this lack, and because of the apparent increase in casualties from phosphorus, the Medical Division, Chemical Warfare Service, was requested to compile all available information on the subject to be forwarded to the theaters in the form of a technical bulletin and to be published in the *Bulletin of the U.S. Army Medical Department.*[40] Hostilities ended before these plans could be carried out.

Thermite, magnesium, and magnesium alloys.—The only medical problems associated with these agents were the removal of metal particles from the tissues and the treatment of the resulting burns, in which approved methods were always employed.

Oil incendiaries.—Oil incendiary bombs and flamethrowers introduced the usual problem of burns. In addition, they caused pulmonary damage and laryngeal and glottic edema if used in enclosed spaces. They also reduced the oxygen content of the air. Treatment consisted of the introduction of fresh

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[37] Informal Monthly Progress Report, Medical Research Laboratory, Medical Division, Office of the Chief, Chemical Warfare Service, 15 Sept. 1944.

[38] (1) Sanitary Report, 8th Infantry Division, XV Corps, ETOUSA, March 1944. (2) Report, 1st Lt Hugo E. Vivadelli and 2d Lt Alex Schlesinger, 44th Chemical Laboratory, ETOUSA, 7 June 1944, subject: Study of the Preparation and Use of Copper Sulfate-Impregnated Pads as First Aid Against Burning White Phosphorus on the Skin.

[39] (1) Memorandum, Capt George R Greenwood, Surgical Consultants Division, for Chief, Medical Division, Chemical Warfare Service, 16 Aug. 1944, subject: Project Specifications for Copper Sulphate Pads. (2) Letter, Medical Research Laboratory, to Chief, Medical Division, Office of the Surgeon General, 11 Dec 1944, subject: Copper Sulfate Pads, with first indorsement thereto, 13 Dec. 1944.

[40] Letter Chief Consultant in Surgery, Surgical Consultants Division, Office of the Surgeon General, to Chief, Medical Division, Chemical Warfare Service, Army Service Forces, 19 June 1945, subject: Systemic Phosphorus Poisoning.

air and, when possible, the use of oxygen in high concentrations. Burns were treated as if they were ordinary thermal burns. Artificial respiration was sometimes necessary.

SCREENING SMOKES

HC (hexachloroethane) mixture.—Serious or even fatal consequences may follow exposure to this smoke in enclosed spaces or near its point of production in the open. The zinc chloride it contains has a damaging effect on the respiratory tract and may produce coughing, choking, and asthmalike symptoms at once, as well as pulmonary edema later. Immediate symptoms are relieved by the intramuscular injection of 0.5 cc. of Adrenalin (1:1,000). Pulmonary edema is treated as if it were caused by phosgene. If exposure has been particularly heavy, BAL in oil is given in appropriate doses, as in lewisite poisoning.

FM (titanium tetrachloride).—This liquid produces acid burns of the skin and eyes, which are relieved by washing with water.

FS (sulfur-trioxide-chlorosulfonic acid solution).—This liquid causes acid burns, and in heavy concentrations it may seriously affect the eyes, skin, and respiratory tract. Minor lesions are treated symptomatically after they have been washed with water. The treatment of burns of the skin, eyes, or respiratory tract depends upon the severity of the damage.

CHAPTER IV

Ophthalmology[1]

M. Elliott Randolph, M.D.

OPHTHALMOLOGY BRANCH

Activation and functions.—The Ophthalmology Branch, Surgical Consultants Division, Professional Service, Office of the Surgeon General, was activated on 15 April 1944. Maj. (later Lt. Col.) M. Elliott Randolph, MC, (fig. 17) who previously had been on duty with the Army Air Forces, became its first chief. The functions of the newly created Ophthalmology Branch were as follows: To establish policies and procedures in general ophthalmology and care of the blind in the Army; to advise on assignments of qualified specialists in these fields; to correlate information and afford consultation and advice pertaining to ophthalmology and care and management of the blind; and to maintain liaison with the Navy, the Veterans' Administration, the Federal Security Agency, and civilian ophthalmologic groups.

Office space was provided for Major Randolph in the office of Lt. Col. Walter H. Potter, SnC, the director of the spectacle program and chief of the Optical Branch in the Medical Supply Division. A cordial and smooth-functioning relationship existed between these two branches.

Shortly after assuming his new duties, Major Randolph was informed by The Surgeon General that he was to be responsible for the program to rehabilitate the blind and deaf. This came as a considerable shock, and, while it seemed somewhat logical that the blind should be his responsibility, rehabilitation of the deaf seemed somewhat out of the question. Fortunately, Major Randolph's superiors in the Surgical Consultants Division shared his sympathies and were able to convince Maj. Gen. Norman T. Kirk, The Surgeon General, that someone else should be brought into the Division to be responsible for the program for the rehabilitation of the deaf. This was later accomplished (p. 105).

CARE OF THE BLIND

Apparently, no provision had been made for the reception and care of blinded casualties until they began to arrive from overseas. These patients filtered into various receiving hospitals and then were turned over to the Veterans' Administration for rehabilitation. Following a Presidential direc-

[1] See also the "Medical Department, United States Army, Surgery in World War II, Ophthalmology and Otolaryngology. Washington: U.S Government Printing Office, 1957."



FIGURE 17.—Maj. M. Elliott Randolph, MC, Chief, Ophthalmology Branch, Surgical Consultants Division, Professional Service, Office of the Surgeon General.

tive, Valley Forge General Hospital, Phoenixville, Pa., and Dibble General Hospital, Menlo Park, Calif., were designated as centers where each blinded casualty was to be sent. In either center, he was to receive certain phases of preliminary social rehabilitation while undergoing definitive medical care. When this had been accomplished, he was to be transferred to Old Farms Convalescent Hospital (Special), Avon, Pa., for a course of 12 weeks' final social rehabilitation. The Presidential directive also stated that every blinded casualty originating in the Army, Navy, or Marines would be sent to an Army facility. The Navy, however, was not in accord with this program and asked that their casualties and also Marine casualties be transferred to the Navy hospital in Philadelphia.

Old Farms Convalescent Hospital (Special)—Plans for the activation of Old Farms Convalescent Hospital (Special)—commonly referred to as Old Farms or Avon Old Farms—were being crystallized upon Major Randolph's arrival in the Office of the Surgeon General. The facility was to be under the overall direction of Col. Frederic H. Thorne, MC, also formerly of the Army Air Forces, and more recently commanding officer of the regional hospital

at Keesler Field, Miss. As the opening of Old Farms drew near, there was curiosity concerning the type of rehabilitation program for the blind that would be established there and who would direct it. Colonel Thorne, it was revealed later, had already asked for the transfer to Old Farms of key personnel from the rehabilitation facilities at Valley Forge General Hospital. Naturally enough, any program for the rehabilitation of the blind would have been successful with such men in control as the director of the program for the blind at Valley Forge, Sgt. (later Capt., MAC) Alan R. Blackburn, Jr., and his two associates, Sgt. (later 1st Lt., MAC) Richard E. Hoover and Sgt. (later 2d Lt., MAC) Paul Conlon. The personnel problem was finally solved by the transfer of Sergeant Blackburn to Old Farms Convalescent Hospital to direct its new program. Sergeants Hoover and Conlon remained at Valley Forge to direct the program there. On 21 July 1944, the first blinded casualties from Valley Forge General Hospital arrived at Old Farms for their final period of social-adjustment training before discharge from the Army.

During the fall of 1944, Major Randolph continued to make trips almost every week to Old Farms. The main purpose of these trips was to permit Lieutenant Blackburn to pour out his tales of woe. The former used every means at his disposal to bolster the morale of the latter. In spite of his unhappiness, Lieutenant Blackburn was doing a magnificent job. Additional personnel were becoming available, and, as the year drew to a close, it appeared that morale was ever improving (fig. 18). At the same time, considerable difficulty was being experienced with the Veterans' Administration because it was believed that this organization was not prepared to assume the responsibility of looking after the blind after the Army had completed its mission of social-readjustment training. At about this stage in the program, Major Randolph was relieved from his assignment in the Office of the Surgeon General (p. 102). A full account of subsequent developments at the Old Farms Convalescent Hospital (Special) is given in another volume of the history of the Medical Department, United States Army.[2]

Valley Forge General Hospital.—Meanwhile, the program for the blind was functioning most efficiently at Valley Forge General Hospital under the overall direction of Lt. Col. James N. Greear, Jr., MC. The program benefited immeasurably by Colonel Greear's foresight and organizational ability. Every available soldier who had had any experience with rehabilitation of the blind was transferred to Valley Forge General Hospital. The specific rehabilitation aspects of the program were under the direction of Sergeant Blackburn until his transfer to Old Farms. He was ably assisted by a number of Army and civilian workers.

Dibble General Hospital.—Inasmuch as it was found necessary to establish an additional rehabilitation center for the blind at Dibble General Hospital, Lt. Col. Norman Cutler, MC, was placed in charge of the eye service and made responsible for initiating a rehabilitation program for the blind

[2] See footnote 1, p. 95.



FIGURE 18 Final social rehabilitation of the blind at Old Farms Convalescent Hospital, Avon, Pa. A, A group of blinded working out adjustment problems in a tension-free atmosphere. B, Riding with sighted guides.

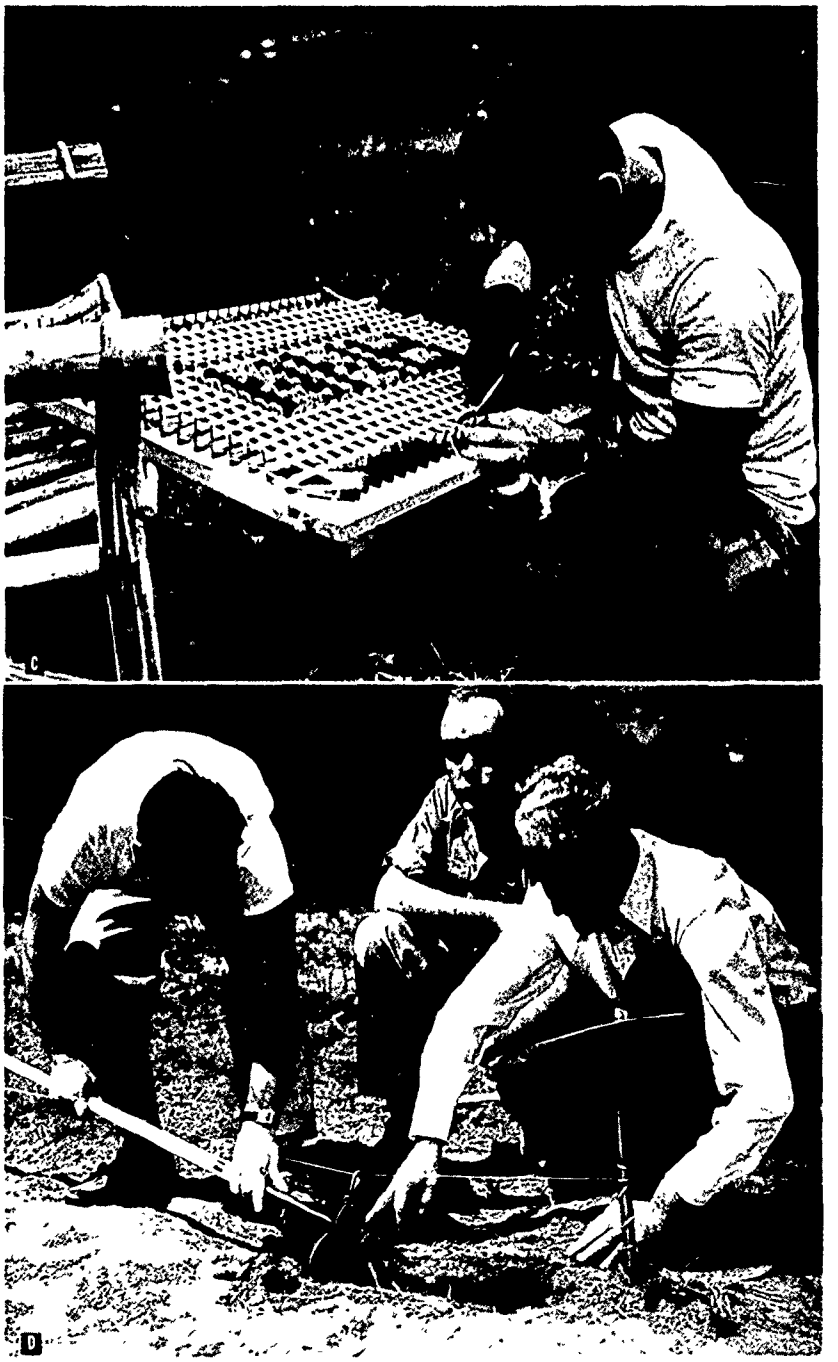


FIGURE 18 Continued. C. Weaving as a hobby and possible future vocation D. Gardening with special tools.

similar to that at Valley Forge General Hospital. He started from nothing, and since all key personnel were at Valley Forge the going was pretty difficult at first. Soon, however, some civilian personnel qualified in rehabilitation of the blind were obtained on the west coast and orienters [3] were trained by the staff at Dibble. Equipment was gradually assembled, and, by October 1944, a training program was running most efficiently. A separate building was erected for projects of the rehabilitation program.

OTHER CONSULTANT ACTIVITIES

Ophthalmologic personnel.—One of the first things the chief of the Ophthalmology Branch did after his arrival in the Office of the Surgeon General was to review the ophthalmologic personnel in each of the eye and plastic surgery centers. Fortunately, this author knew personally the chief of the eye section at most of the centers and kept in contact with their problems through personal telephone calls. The equipment situation was fairly satisfactory, but all the centers were in critical need of additional ophthalmologists. As the patient census at each hospital became greater after D-day, the need for additional trained ophthalmologists became more apparent. The Army Air Forces released about 10 qualified ophthalmologists who were eagerly pressed into service and distributed to the various eye centers. The ideal of 1 ophthalmologist to 50 patients was never realized. At Valley Forge General Hospital, the largest of the eye centers, the average was about 1 to 190.

Field trips.—During this time, the consultant in ophthalmology made numerous trips to Valley Forge General Hospital because of its proximity. There, he learned firsthand some of the problems concerning the rehabilitation of blinded casualties and also the needs and problems of the clinical side of Army ophthalmology. About the last of May 1944, the consultant in ophthalmology visited the eye services at Woodrow Wilson General Hospital, Staunton, Va., Nichols General Hospital, Louisville, Ky., and Lawson General Hospital, Atlanta, Ga. Each service was staffed with a particularly outstanding ophthalmologist, and the services were excellently run. Major Randolph visited Dibble for the first time during the summer of 1944. The eye cases were beginning to overflow, and there was a great need for more space and more trained ophthalmologists, a situation which was not alleviated.

Civilian consultants in ophthalmology.—On 2 September 1944, Major Randolph wrote a personal letter to each surgical consultant in each service command designating the types of eye cases which should be sent to various hospitals and, in addition, recommending that a civilian consultant in ophthalmology be appointed in each service command. Certainly, each plastic and eye center was located conveniently near a large medical center so that the use of civilian consultants could have been very practical and helpful. Nothing,

[3] Orienters was an appellation given enlisted personnel who were assigned to a newly blinded person to watch over him and to orient him in every respect with reference to his person and his environment.

however, came of the recommendation except in the Ninth Service Command, where Dr. Frederick Cordes of San Francisco kept in close touch with Dibble General Hospital and was tremendously helpful.

Acrylic artificial eyes.—In March 1944, General Kirk returned from his visit to the European theater where he was impressed with the achievements of the new plastic artificial eye which had been devised by Capt. (later Maj.) Stanley F. Erpf, DC, at the 30th General Hospital, England. He conceived the idea of recalling Captain Erpf to this country to work on standardizing production techniques with two other dental officers who had been experimenting along similar lines in the Zone of Interior, Maj. Milton S. Wirtz, DC, and Maj. Victor H. Dietz, DC. Inasmuch as the stock of artificial eyes in this country was being rapidly depleted, it was extremely fortunate that the process of fabricating such eyes from dental acrylic was discovered at that time. This project was the responsibility jointly of the Optical Branch under Colonel Potter, his associate Mr. Stanley W. Rybak, and the Ophthalmology Branch.

It was decided that a training center for the fabrication of plastic artificial eyes would be set up at Valley Forge General Hospital, and each service command was instructed to send one or two dental surgeons for a period of 4 to 6 weeks' training under the tutelage of the aforementioned officers. Although those in charge of the project were assured in emphatic terms that there was not an inch of room available at Valley Forge, adequate space was, nonetheless, quickly found and the program became an outstanding success. These dental officers were then distributed, after a training period, to the eye centers throughout the country and they, in turn, set up laboratories for training enlisted personnel. The program kept functioning in each hospital until the closing of each center.

Liaison with consultants in ophthalmology overseas.—Major Randolph, during his first term in the Office of the Surgeon General, kept in contact with Col. Derrick T. Vail, MC, the senior consultant in ophthalmology in the European theater. Colonel Vail's needs were mostly those of ophthalmic supplies, and the filling of his demands was speeded up in this country whenever it was possible. Maj. (later Lt. Col.) Trygve Gundersen, MC, was a part-time consultant in the Mediterranean theater. Major Randolph kept in fairly close contact with him. The author, however, knew nothing whatsoever about ophthalmologic consultants in the Pacific areas. His personal friends among the ophthalmologic personnel who had been so unfortunate as to be sent to the Pacific all wanted but one thing—to be sent home as quickly as possible.

First tour ends.—About Christmas 1944, Colonel Vail arrived in the United States from Europe. Strangely enough, the thought immediately occurred to Colonel Greear that he had had enough of Valley Forge General Hospital and was most anxious to get into administrative work again. He calculated, also, that Major Randolph was more than anxious to get into

clinical work and away from administrative work. Thus, it seemed to him that Colonel Vail might be the solution to each problem. Major Randolph never knew quite how the details were worked out, but on 22 February 1945 he was transferred to Valley Forge General Hospital, Colonel Greear was transferred to Europe, and Colonel Vail took over as chief of the Ophthalmology Branch. This seemed to satisfy everybody but Colonel Vail. As usual, however, Colonel Vail did the job in his customary, superb way. Meanwhile, Major Randolph was promoted to lieutenant colonel in January, shortly before his reassignment to Valley Forge General Hospital.

THE SECOND TOUR

Colonel Vail remained as the consultant in ophthalmology and chief of the Ophthalmology Branch until 28 July 1945. He was succeeded by Major Gundersen, who requested and received his release from the Army about the end of November 1945. Again, Colonel Randolph was notified by Lt. Col. Michael E. DeBakey, MC, that his former position was open and that there was not enough time to train another man to take over. Colonel Randolph resumed his former position on 8 December 1945.

A bright spot of these early days in Washington during December 1945 was the consultant's relationship with Brigadier Sir Stewart and Lady Duke-Elder who had been invited to this country by General Kirk. Sir Stewart had been the consulting ophthalmologist to the Royal Army throughout World War II. Colonel Randolph accompanied them on a tour of several hospitals in the East, and it was a great experience. Colonel Randolph spent the remaining months in the Office of the Surgeon General working on the history of ophthalmology in World War II. In April 1946, when he finally convinced Colonel DeBakey that this history had been completed, he was released from the Army.

RECOMMENDATIONS

One cannot be associated in an administrative medical position in the Army without realizing that certain recommendations should be given serious consideration. The following recommendations in the event of another national emergency are prompted by the author's experiences as the consultant in ophthalmology to The Surgeon General during World War II:

1. A consultant in ophthalmology should be placed on active duty at once in the Office of the Surgeon General. If a man of high qualification is present in the Army, let him be considered as consultant. If such a man is not available, the executive committee of the American Ophthalmological Society might be asked for its opinion as to a desirable civilian ophthalmologist.

2. Upon the activation of each oversea theater, a consultant in ophthalmology should be placed on duty at once and be made responsible for the ophthalmologic program within the theater. Whether he should serve part

time or full time in this capacity would depend upon the size and burden of the theater.

3. On the assumption that there will be an eye center in each service command, or similar command in the Zone of Interior, the chief of the center (presumably an ophthalmologist of outstanding qualifications and competence) should serve part time as consultant in ophthalmology within the command. In particular, he should advise the service command surgeon on the qualifications and assignment of ophthalmologists. The policy of having the surgical consultant or the surgeon of the command evaluate the qualifications and make the assignment of such highly specialized physicians as ophthalmologists is open to question.

4. A consultant in charge of the care of blinded casualties should be appointed immediately. He should be chosen after consultation with leading authorities in the field, and should have had a long and outstanding experience in work with the blind. He should work closely with the consultant in ophthalmology, but he would probably serve as well in a civilian capacity as in a military capacity. In World War II, the delayed appointment of a consultant in charge of the care being given blinded casualties seriously delayed the program.

5. An optical section should be activated at once in the Office of the Surgeon General and should be given responsibility for all supplies and for the administrative details of the artificial-eye program. It should work in close cooperation with the consultant in ophthalmology. An officer, thoroughly experienced in the problems of optical and medical supplies and possessing special familiarity with the spectacle program, should be assigned to the office of the consultant in ophthalmology in each oversea theater.

6. The ophthalmologic and otolaryngologic services should be separated administratively in large installations, such as regional and general hospitals. A competent man should head each service, and he should be independently responsible to the chief of surgery. A single chief of section in the ophthalmologic service cannot possibly provide competent administrative and professional supervision of a patient load of 200 per officer, as was frequently required in World War II.

7. Monthly reports should be submitted by oversea consultants to the consultant in ophthalmology in the Office of the Surgeon General. Abstracts of these reports could then be incorporated in a monthly newsletter for distribution to oversea and Zone of Interior installations.

8. During basic training, all medical officers should receive a certain number of lectures on traumatic ophthalmology. More advanced work could be made available in elective courses.

9. Articles dealing with military ophthalmology should be microfilmed for general oversea distribution. This activity should be one of the responsibilities of the consultant in ophthalmology in the Office of the Surgeon General.

10. During World War II, the Army Air Forces convinced many doctors of the desirability of joining this branch with the result that an unnecessarily large number of outstanding ophthalmologists joined the Army Air Forces and spent the rest of their Army days performing the most trivial types of ophthalmology in regional and station hospitals. A large number of this country's then leading ophthalmologists were responsible for large clinics in Florida and the Southwest. The need for such men in the huge Army eye centers was glaringly apparent. The hospitals in which these men were serving could have been handled adequately by an ophthalmologist who had recently received certification by the American Board of Ophthalmology eligible for such certification.

CHAPTER V

Otolaryngology

Leslie E. Morrissett, M.D.

ESTABLISHMENT OF OTOLARYNGOLOGY BRANCH

Until the middle of 1944, the specialty of otolaryngology had no official representation in the Office of the Surgeon General. Individual chiefs had the responsibility for the conduct of their otolaryngologic sections, which were usually organized under the surgical services, in hospitals throughout the Zone of Interior. If problems in this field reached the Professional Service, Office of the Surgeon General, the usual policy was to refer them to the chief of the ear, nose, and throat service at Walter Reed General Hospital. Three civilian consultants in otolaryngology had been appointed early in the war and were available for consultation. They were Dr. Albert C. Furstenberg, Ann Arbor, Mich., Dr. Dean McAllister Lierle, Iowa City, Iowa, and Dr. John Mackenzie Brown, Los Angeles, Calif.

The program for aural rehabilitation of the deafened and hard of hearing, which eventually became the most important consideration of otolaryngology in World War II, was set up under the direction of the Reconditioning Division, Professional Service, Office of the Surgeon General. The impetus for the creation on 15 June 1944 of the Otolaryngology Branch, Surgical Consultants Division, Office of the Surgeon General, was the need for a reorganization of this program. As a matter of fact, when the consultant in otolaryngology was finally appointed, the magnitude of the rehabilitation program made it necessary for him to give almost his entire time to it and left him little time for other duties in the specialty of otolaryngology.

Although there had been a realization of the potential importance of the problem of the deafened soldier as early as May 1943 (p. 112) and the realization had been implemented by the establishment of three specialized centers for the treatment of defective hearing, the initial program was under the direction not of an otologist but of a psychiatrist. In June 1944, Brig. Gen. Fred W. Rankin, Chief Consultant in Surgery to The Surgeon General, following a visit of inspection to two of the three hearing centers, reported to The Surgeon General that the chief defect of the current program was the total lack of uniformity in the operation of these centers. He recommended that, to overcome this defect and to improve the program in other ways, an otologist be placed on duty in the Office of the Surgeon General to devote his full time to the program for the deaf. This recommendation had been discussed informally by per-



FIGURE 19.—Maj. Leslie E. Morrissett, MC, Chief, Otolaryngology Branch, Office of the Surgeon General.

sonnel concerned with the program since it had first been instituted and had been a matter of particular concern to the late Dr. Walter Hughson, Otological Research Laboratory, Abington Memorial Hospital, Abington, Pa., then serving as a civilian consultant in otology.

General Rankin's recommendation was implemented on 13 July 1944 with the activation of the Otolaryngology Branch and the appointment of Maj. (later Lt. Col.) Leslie E. Morrissett, MC, as Branch chief (fig. 19). Major Morrissett had been chief of the eye, ear, nose, and throat service at Borden General Hospital, Chickasha, Okla., where his duties had included the direction of the Rehabilitation Center for the Deafened and Hard of Hearing.

CLINICAL POLICIES

Clinical policies did not require a great deal of Major Morrissett's attention. These policies were fairly well established by the time of his appointment and, in general, followed the policies then in effect in civilian practice.

Elective surgery of the nose, throat, and ears was prohibited except on very clear-cut indications. Since, however, nasal and pharyngeal defects were not usually regarded as causes for rejection, many men inducted into the Army required otolaryngologic treatment, and the volume of this work was sometimes quite large.

Tonsillitis was the most frequent otolaryngologic diagnosis in Zone of Interior hospitals, but tonsillectomy was permitted only when it was regarded as absolutely essential for the maintenance of the health and military effectiveness of the individual soldier. Rigorous enforcement of this rule produced no deleterious results. Acute tonsillitis was treated by routine measures, including the use of penicillin after it had become available.

Pharyngitis and nasopharyngitis occurred in much the same frequency as in civilian life except for the epidemics which often followed the arrival of increments of new troops in camps. Treatment was by the methods ordinarily used in civilian life. Surgery was not permitted for deviations of the nasal septum except when the deflection was marked and was attended with obstructive symptoms, headaches, and complaints referable to the ears.

Elective surgery on the larynx was limited to the removal of polyps and papillomas. The incidence of carcinoma of the larynx was surprisingly high, in view of the youth of the Army group. Laryngectomy was usually performed, but an occasional patient was treated by the irradiation technique of Cutler.

Otitis externa, while chiefly a problem in the Pacific, was sometimes observed in Zone of Interior hospitals, particularly in the South. A variety of antiseptic and chemotherapeutic methods were employed in its management, but there was no doubt that the essential phase of treatment was strict cleanliness of the external auditory canal.

Otitis media furnished the same constant problems that it does in civilian life. Although the chronic condition was not regarded as a cause of rejection for service, it was often necessary to arrange for certificate of disability discharges for men suffering from it. Management of both acute and chronic otitis media was by the practices then prevalent in civilian life. The sulfonamide drugs were used until penicillin became available and was added to the armamentarium. The fact that there were only a few cases of mastoiditis was considered by some observers to be attributable to the use of these agents. However, the general impression was that, while these agents might have been helpful in some cases of acute otitis media, they were of doubtful value in acute exacerbations of the chronic disease and were of no value at all in chronic cases. Insufflations of sulfanilamide powder, which at one time were very popular, later were universally believed to be both ineffective and harmful. It was unfortunate that the masking effects of chemotherapy and antibiotic therapy were not more generally realized. Inexperienced physicians did

not always appreciate the fact that relief of symptoms was not necessarily synchronous with the resolution of infection.

The volume of cases of chronic sinusitis was very large. Like otitis media, this disease was not regarded as a cause for rejection of draftees, and a considerable number of men later had to be given certificate of disability discharges for this reason. Sinusitis was sometimes a complication of the epidemics of nasopharyngitis which followed the arrival at camps of increments of troops fresh from civilian life. Therapy followed the usual civilian practices, and elective surgery was discouraged. The systemic use of the sulfonamides and penicillin was sometimes valuable in acute cases in which the micro-organisms were sensitive to these agents, but, as in otitis media, they were of no value in chronic cases and their masking effects were often harmful.

Bronchoscopy and laryngoscopy were used for both diagnostic and therapeutic purposes upon the proper indications. The fenestration operation was not permitted. Rhinoplastic surgery for cosmetic or other reasons was permitted in a few special cases, but for other reasons—for example, physiological reasons—it was permitted in indicated cases. In these instances, it was done by otolaryngologists with special training and with the express permission of the hospital commanding officer.

Anesthesia was a matter of the individual surgeon's preference. Endotracheal anesthesia gradually became popular for radical operations on the antrum and mastoid, which, as just indicated, were not numerous. Tonsillectomy was performed under some form of general or local anesthesia.

After the activation of the Otolaryngology Branch in the Office of the Surgeon General, special cases which formally would have been referred to the chief of the ear, nose, and throat service at Walter Reed General Hospital now reached the consultant in otolaryngology through channels. Most of the cases which reached the consultant through the physical evaluation review board in the Office of the Surgeon General concerned the disposition of patients. Cases which concerned West Point cadets had to do with whether otolaryngologic conditions such as perforated eardrums would warrant continuation at the Academy or would require dismissal on the basis of physical disability. Army regulations governed decisions on these cases.

The recommendations made by the consultant in otolaryngology in the Office of the Surgeon General were, of course, not directive in force. In one particular case, which had occupied much time and thought and for which the recommendations were made jointly by several consultants, the commanding officer of the hospital declined to accept the recommendations and continued to refuse to accept them even after active intervention by General Rankin. This was not a usual situation, of course, but one which did occasionally occur and for which no immediate remedy was obvious.

ROUTINE ADMINISTRATIVE PROCEDURES

Hospital Organization and Personnel

Policies on hospital organization were already well established when the Otolaryngology Branch was activated in the Surgical Consultants Division, Office of the Surgeon General, in July 1944. As a rule, sections of otolaryngology were a part of the surgical service. In a few hospitals, otolaryngology was a separate service. In most, sections on otolaryngology and ophthalmology were conducted conjointly by a single officer trained in one branch or the other or, very occasionally, in both. This was obviously an undesirable state of affairs. In small station hospitals, where there was, perhaps, no other solution to the problem, patients who needed specialized care in the field in which the section chief was not trained were transferred to general hospitals. In larger hospitals, the policy of combined services was unfortunate. There were shortages of specialized personnel, it was true, but the popular explanation of the situation was that the tables of organization which provided for the joint management of two widely dissimilar specialties were the result either of the operation of the Office of the Surgeon General under the Army Service Forces or of the failure to provide for a consultant in otolaryngology on the proper level to advise upon such matters.

By July 1944, most hospitals, both those in the Zone of Interior and those designated for oversea service, were fully manned, but otolaryngologic personnel were now in short supply. Later, in a number of instances, recommendations for changes in assignment were made and were based on personal observation of competence or were regarded as valid for other reasons. However, for one reason or another, none of these recommendations was implemented.

The Army Air Forces, which were then part of the Army, had a surplus of well-trained otolaryngologic personnel who were not very busy. Recommendations for transfer of some of these officers to make up for shortages in Army hospitals in the Zone of Interior and overseas were made informally but were not acted upon.

Equipment and Supplies

Consultations with the proper authorities concerning equipment and supplies for otolaryngology were, as a rule, very disappointing, probably because, again, the Otolaryngology Branch, Office of the Surgeon General, was activated at such a late date. The errors were those which might have been expected in lists of equipment made up, as a rule, by medical officers with no special training in otolaryngology.

As a rule, however, serious deficiencies were not numerous. Improvisations were sometimes necessary, but no patients really suffered because of lack of equipment. There were numerous complaints, but most of them could be explained by the rather general desire of surgeons in all fields to want more

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than they have. On the other hand, much of the equipment was far too elaborate. It was a good deal more than most otolaryngologists were used to in civilian practice and was entirely unnecessary in view of the limited amount of surgery permitted in many installations. Hospitals which needed more equipment either improvised it or secured it on loan from general surgery services.

There were, however, a number of deficiencies in the equipment for the hearing centers. Audiometers were in limited supply for a long time. These were delicate instruments frequently in need of checking and repair, and their maintenance was slow and difficult. In many instances, insufficient space had been provided for proper testing (20-foot lanes), and the areas were not sound conditioned or correctly located. In at least one hospital, the room for audiometric testing was adjacent to the motor pool. These deficiencies were partly due to failure to appoint a consultant in otolaryngology until late in the war and were partly a reflection of the status of audiology before the war.

OTHER DUTIES

Hospital construction.—The professional duties of the consultant included the making of recommendations concerning construction and equipment in new hospitals and alterations in existing hospitals. These duties required consultation with appropriate sections of the Office of the Surgeon General and were chiefly concerned with the hearing centers. Professional advice in regard to these centers was usually readily accepted.

Special centers.—In addition to the centers for the treatment of hearing impairments, special centers were established for the treatment of laryngeal and esophageal cases and for speech defects. The speech defects were principally from head injuries, and the centers, which were never very active, were operated in conjunction with neurosurgical and neurologic personnel. The principal center for the treatment of laryngeal injuries, which injuries proved far more numerous than had been expected, was at Walter Reed General Hospital.

Field trips.—Each of the hearing centers was visited several times when necessary, but travel by the consultant in otolaryngology was otherwise strictly limited. He was not included in any of the so-called "Flying Circus" trips, in which groups of officers in the Office of the Surgeon General traveled by air to various hospitals in the Zone of Interior to study the administrative organization, the functioning of the various services, and the care of patients. Other consultants, however, were included in these "Flying Circus" trips from time to time.

The personal observation, which would have been possible had the policy on travel been less restrictive, would have obviated the difficulties which arose from correspondence regarding personnel. In numerous instances, letters were received from otolaryngologists concerning assignments, equipment,

therapeutic methods, and other matters which were not always easy to evaluate at long distance. Some of these letters could, of course, be discounted upon the first reading. In other instances, however, though the complaints seemed justified, it was almost impossible to recommend action without personal observation. In only one instance was such personal observation permitted. On that occasion, it was recommended that the officer in question be transferred to another installation in which his duties would not provide the opportunities for the surgery he was attempting.

Liberal use of the long distance telephone compensated to some degree for the restraints upon travel by the consultant in otolaryngology.

Liaison.—Liaison with various otolaryngologic organizations and with lay and other organizations concerned with this field was one of the duties of the consultant in otolaryngology.

After his appointment to this position, this consultant served on the Subcommittee on Otolaryngology, Division of Medical Sciences, National Research Council, and replaced the medical and administrative officers who had served previously on the Subcommittee. He was also appointed alternate liaison officer and, later, liaison officer on the Committee on Sensory Devices, Office of Scientific Research and Development.

Liaison officers were invited to all section meetings of Office of Scientific Research and Development committees, at which their special projects were discussed. Direct and official contact was permitted with National Defense Research Committee contractors without violation of rules concerning communication through official channels. No substantial change in research projects was permitted without the approval of the responsible supervising division of the Office of Scientific Research and Development, but this arrangement provided frequent and helpful contacts with persons concerned in these projects. Many of the practical results of the research carried out by the special committees of that office were applied at the hearing centers as preliminary data became available, but the war ended before these projects were completed.

Other groups with which liaison was maintained included the American Academy of Ophthalmology and Oto-Laryngology; the American Otological Society; the American Laryngological Society; the Section on Laryngology, Otology and Rhinology of the American Medical Association; the American Broncho-Esophagological Association; the Triological Society (the American Laryngological, Rhinological and Otological Society); the American College of Surgeons; and the American Board of Otolaryngology. For the most part, liaison was effected informally, frequently by telephone or by personal contact. These contacts, however, were extremely profitable in that specialists in the field could be kept informed of Army problems and progress and that the consultant in otolaryngology, in his turn, could keep abreast of therapeutic and other advances.

Close liaison was maintained also with the American Hearing Society through its central office in Washington; the Volta Bureau of the Alexander Graham Bell Association for the Deaf; and other lay organizations. These contacts frequently brought to the attention of the consultant in otolaryngology both general problems and special cases.

The consultant in otolaryngology served as a member of the Subcommittee on Audiometers and Hearing Aids of the American Standards Association and attended several meetings. At a conference on underwater sound at the U.S. Submarine Base, New London, Conn., a paper was presented as part of a symposium on this subject.

The consultant attended meetings of specialized societies and presented talks on the occasion of special meetings, such as the silver anniversary meeting of the New York League for the Hard of Hearing when it met with the Otolaryngology Section of the New York Academy of Medicine, New York, N.Y., in 1944.

Close liaison was maintained with the Veterans' Administration, chiefly through informal conferences. The relationship was invariably cordial and cooperative, and it was believed that a good groundwork had been laid for the assumption by the Veterans' Administration of the care of deafened veterans after the war.

Public relations.—A large part of the consultant's duties had to do with a field that might be termed public relations. This included correspondence on special cases with members of Congress who forwarded letters from their constituents. These letters usually dealt with physical disabilities which, it was believed by the soldiers' parents, would be jeopardized by continuation of service, by continued service in the present assignment, or, in particular, by oversea service. The most usual reasons listed were sinus trouble, hearing defects, headaches, and a former history of mastoid disease. Each of the cases was, of course, investigated, but only very occasionally was the request regarded as justified from the standpoint of the soldier's well-being.

AURAL-REHABILITATION PROGRAM FOR THE DEAFENED AND HARD OF HEARING

Background and General Considerations

The impetus to the appointment of a consultant in otolaryngology in the Office of the Surgeon General in July 1944 was, as already mentioned, the need for changes in the Army aural-rehabilitation program. The description of this consultant's functions, in fact, began with a statement of his responsibility for the establishment of policies and procedures in the care of the deaf in the Army.

Specialized centers for the treatment of Army personnel with defective hearing sufficient to preclude their return to duty had been set up in May 1943 at Borden General Hospital (fig. 20); Hoff General Hospital, Santa

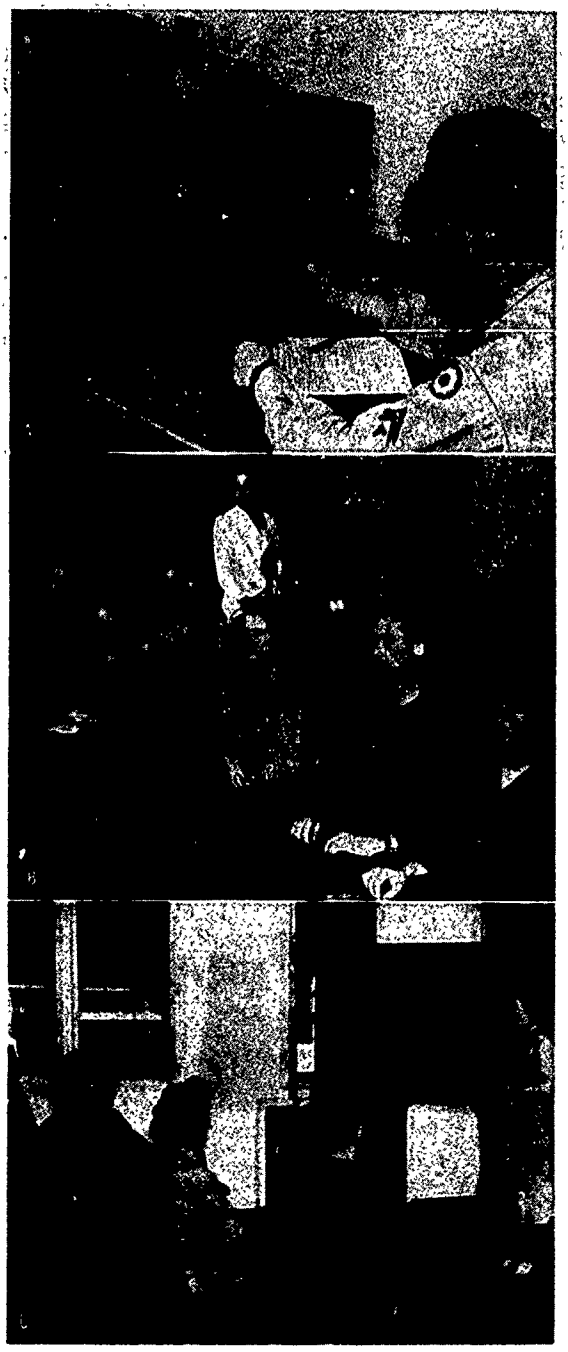


FIGURE 20.—Aural rehabilitation at Borden General Hospital, Chickasha, Oklahoma. A. Audiometric assessment of hearing loss. B. A group learning lipreading with the aid of motion pictures. C. Practice class in lipreading.

Barbara, Calif.; and Walter Reed General Hospital, Washington, D.C. The center at Walter Reed General Hospital was transferred to Deshon General Hospital, Butler, Pa., in September 1943 (fig. 21). The first phase of the program was under the direction of a trained psychiatrist, Maj. (later Lt. Col.) Walter E. Barton, MC, Assistant Director, Reconditioning Division, Office of the Surgeon General.

By January 1944, the increase in the patient load at the specialized centers had resulted in so many problems that a conference on the whole subject of rehabilitation of the deafened was authorized by The Surgeon General and was held at Hoff General Hospital, 2–4 February 1944. The mere perusal of the recommendations made by this conference made it evident that the three specialized centers for rehabilitation of the deafened were operating, for all practical purposes, as individual units, and this lack of coordination was one of the chief reasons for the establishment of an Otolaryngology Branch.

The reorganized program is described in detail in the volume in this series concerned with otolaryngology, but certain of the essential facts require repeating here.

The problem with which the Army found itself confronted in the rehabilitation of the deafened and hard-of-hearing soldier had no parallel in civil life, either in the number of patients to be dealt with or, in some cases, in the circumstances of their deafness. At the beginning of the aural-rehabilitation program, the following three special difficulties had presented themselves:

1. The material used in the teaching of the hard of hearing in civilian life was almost entirely directed toward children.

2. The Army at this time had neither the trained personnel to conduct such a program nor the technical personnel to build, install, and maintain the essential electroacoustic equipment.

3. Highly specialized and difficult-to-obtain equipment was required.

Development of the Program

The first duty of the newly appointed chief of the Otolaryngology Branch was to survey the situation at the three hearing centers. An analysis of the data secured made it clear that deafened and hard-of-hearing patients had, on the whole, received excellent care and that the chief deficiencies of the program at this time had to do with lack of equipment, shortages of personnel, and lack of uniformity and procedure. True, corrective action was being taken to overcome these deficiencies, but the added impetus provided by the appointment of the consultant in otolaryngology to coordinate and integrate activities undoubtedly accelerated development of the full-fledged program which eventually evolved. The following developments were particularly noteworthy:

Equipment.—A list of basic equipment was drawn up with the assistance of Dr. Richard K. Silverman, director of the Central Institute for the Deaf, affiliated with Washington University, St. Louis, Mo., and Mr. C. E. Harri-

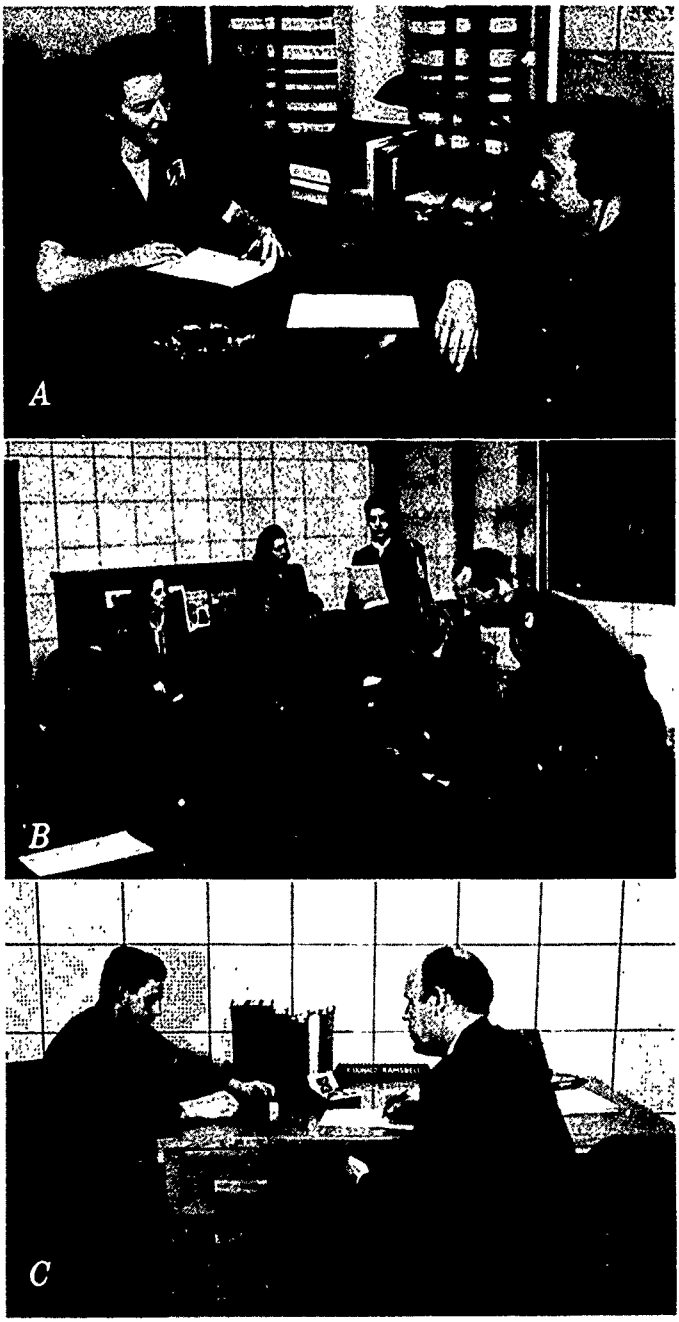


FIGURE 21.—Aural rehabilitation at Deshon General Hospital, Butler, Pa. A. Speech interview and evaluation. B. Administration of the Larsen discrimination test. C. Psychological evaluation of mental abilities and aptitudes for rehabilitation counseling.

son, who had had many years of experience in electronics at this institution. In July 1944, all three centers were still without sound-level meters, magnetic-tape recorders, some units of electroacoustic equipment, and other equally basic items. However, by 1 November 1944, most of the essential equipment had been procured and installed in all three centers. At the same time, utilization and disposition of the equipment, which previously had varied widely, were standardized and made uniform.

Personnel.—The staffs already at work in the hearing centers in July 1944 were augmented as rapidly as possible to meet expected patient loads. Qualified personnel already in service were identified from a search of personnel records in The Adjutant General's Office and assigned to the centers. All organizations working in the field, both lay and professional, governmental and private, were solicited for assistance. Eventually, an adequate number of both military and civilian personnel were secured for the positions open in the hearing centers.

When, on early visits to the centers, it was found that otologists specially trained for the program were being assigned to other duties and that their specialized skills were not being fully utilized, the importance of retaining intact the organization which had been set up was explained to responsible officers in the service commands, and the time, effort, and monies expended in the training of personnel were emphasized. Later, a War Department memorandum stressed the importance of retaining in their specialized capacities critically needed specialists, among whom were listed psychiatric social workers, lipreading specialists, speech correctionists, and acoustic technicians.

Organization.—Under the plan of reorganization put into effect by the consultant in otolaryngology, an otologist directed the aural-rehabilitation program at each center. Medical officers became responsible to the otologist for the diagnostic and therapeutic management of the patients, whereas, formerly, the program had operated as a group of separate services. Although compliance with the basic plan of organization was insisted upon, each center was given latitude for the expression of individual initiative in its program. Facilities for the transmission of information from center to center insured the rapid utilization for all patients of any policy or procedure which had proved of value in a single center.

Selection of patients.—The standards of hearing acuity under which men were inducted into service obviously permitted the entrance of many with markedly defective hearing. Moreover, the tests by which acuity was determined were admittedly inaccurate. Originally, a hearing loss of 60 decibels was required for admission to the centers. Later, the hearing loss requirement was reduced to 30 decibels, which experienced otologists regarded as much fairer, even though it would materially increase the load on the special centers.

Expansion.—The original plan was that each aural-rehabilitation center should maintain a maximum load of 250 patients. As the patient load increased, problems of additional expansion continued to arise. Early in 1944,

various estimates brought the maximum number of casualties who might require treatment for deafness within the year to more than 13,000. Available facilities would not permit the handling of more than 4,000 per year, even if the turnover continued as expected. Additional facilities were therefore planned for between 4,500 and 9,000 patients per year, which would require, on the basis of a 10-week hospital residence, an additional bed capacity of between 900 and 1,750 beds.

Later, it was found more practical to manage patients admitted to the centers for aural rehabilitation as convalescents, and, under this plan of management, the proposed additional hospital facilities were considered unnecessary. The plan of transferring patients in the hearing centers to convalescent barracks was originally undertaken experimentally, but it proved both feasible and practical. In addition to releasing hospital beds for other, more urgent purposes, it removed the patient from a hospital atmosphere, improved his morale during the period of rehabilitation, and permitted a desirable program of activities outside of actual aural rehabilitation which could better be carried out away from the regimentation and discipline necessary in hospital wards.

Hearing aids.—War Department Circular No. 81, issued on 23 February 1944, limited the prescription and fitting of hearing aids to the special hearing centers, except for patients in general hospitals under treatment for conditions which precluded their transfer to special centers (fig. 22). The original policy was to supply aids only to men whose impairment had been suffered in line of duty. Later, on 23 February 1944, this policy was altered and aids were furnished to all deafened men in service, regardless of when or how the impairment had originated.

The situation in respect to hearing aids was altered in the reorganized program in several ways. Scientific tests were devised to determine the special aid suited to the needs of the individual patient. Patients themselves were completely separated from commercial contacts. Savings in both time and money were effected by having the individual Lucite tips for the patients made by trained technicians in Army dental laboratories and by letting indefinite quantity contracts for the purchase of aids most frequently used, as determined by survey.

Narcosynthesis.—One of the outstanding developments of the aural-rehabilitation program was the management of cases of psychogenic deafness by narcosynthesis. The results in the first cases in which this method was applied were so good that its use was extended, and, in all, 102 patients were thus treated at the Hoff Center, with the cooperation of the otologist, the psychiatrist, and the psychologist. Although this technique was highly successful in military circumstances, it was doubted that it would be as effective in civilian life.

Civilian consultants.—Valuable suggestions concerning the aural-rehabilitation program were made by the late Dr. Walter Hughson, before the



FIGURE 22. Prescription and fitting of hearing aids. A. Various types of hearing aids being tested for the reception of normal speech. B. Demonstration of the wearing and use of a particular type of hearing aid.

establishment of the Otolaryngology Branch in the Surgeon General's Office. Mention has already been made of the assistance rendered by Dr. Richard K. Silverman and Mr. C. E. Harrison in the planning and procurement of special equipment. The latter two individuals made a number of trips to the centers in connection with the designing and installation of this equipment, and Dr. Silverman made valuable suggestions for the lipreading and speech-correction programs. Dr. Gordon Berry, then President of the American Otological Society, gave generously of his time and supplied valuable advice when the program was in its earliest stages as well as after the Otolaryngology Branch had been established. Dr. Hallowell Davis and others of the psychoacoustic laboratory of Harvard University gave valuable help in various aspects of the program for the treatment of the deafened soldier.

Early in the program, Dr. Douglas Ross was assigned to Deshon General Hospital in connection with the otologic studies of the National Defense Research Committee. His association with the staff there proved of so much benefit that at the suggestion of the consultant in otolaryngology he also visited the other centers, where he held numerous conferences with the staffs and was able to iron out many difficulties on the basis of his experience in similar situations at the Deshon Center.

Maj. Victor O. Skyberg, SnC, who had had a wide experience in civilian life as both teacher and administrator at the New York School for the Deaf, White Plains, N.Y., at Gallaudet College, Washington, D.C., and at the Minnesota School for the Deaf, Faribault, Minn., visited Borden and Hoff Centers late in 1944 and would have visited the Deshon Center except for his untimely death just as his tour of duty at the Hoff Center was concluded. Major Skyberg's constructive criticisms resulted in further standardization of methods at all centers and in other improvements.

Followup.—Unfortunately, no adequate followup studies were made within the Army on patients discharged from the hearing centers. The Deshon center, however, investigated, by means of questionnaires, 468 of its patients who had been discharged with hearing aids. The personal impressions of workers in the program were that a large proportion of the patients returned to civil life had made highly satisfactory adjustments. In many instances, it was stated that the standards of living, as the direct result of aural rehabilitation, were actually higher than they had been previously. This was especially true of those whose hearing had been impaired before their induction.

Conclusions

Although nothing new was revealed during the war about the problems of patients who were deafened or who had suffered severe damage to their acoustic mechanism, the mass of military casualties permitted a study of the whole field of deafness which would have been impossible in civilian life. Much of the accumulated data merely confirmed previous impressions, and much of it was inconclusive. Nonetheless, it would be fair to say that, as a result of

the wartime experience, the treatment of deafness was advanced by at least two decades.

The integration of the aural-rehabilitation program was perhaps its most significant aspect. For the first time, there were placed under a single roof, a large-scale collaboration, the otolaryngologist who specializes in otology, the acoustic engineer, the psychologist, the social worker, and the teacher of the hard of hearing. Each specialized center was provided with the best possible equipment. Every member of the staff was a specialist in his field. Some teachers were themselves as handicapped as their pupils and were vital illustrations of what handicapped persons can accomplish. Every phase of the program was carefully planned, with the objective of making it as intensive and, at the same time, as streamlined as possible. Eventually, as would have been desirable from the beginning, an otologist was put in overall charge of the program, since auditory impairment, regardless of its social and emotional complications, was primarily a medical problem.

In all, some 9,500 deafened and hard-of-hearing soldiers were treated in the three aural-rehabilitation centers.

RECOMMENDATIONS

In retrospect, the prime achievement of the Otolaryngology Branch, Surgical Consultants Division, Office of the Surgeon General, was the operation of the specialized centers for the treatment of deafened and hard-of-hearing soldiers. It was unfortunate that the uniform program finally put into operation at all of the centers was not instituted as soon as the centers were established. It was equally unfortunate that the program did not develop originally under otologists, the specialists primarily responsible for the management of hearing impairments.

For these and other reasons, it is indicated that in the event of another war an otolaryngology branch should be created at once as one of the specialty branches in the Office of the Surgeon General, if such a branch should not exist at the time, and regardless of the form the organization of this office may take in the future. It would be fair to say, without unduly magnifying the importance of the specialty, that many of the problems which arose during the early years of the war concerning personnel, equipment, therapy, and other considerations would not have arisen had an otolaryngologic consultant been available for advice and guidance.

It should be pointed out also that the rank of the consultant in these fields should at least approximate the ranks of other consultants in the various specialties. An officer in the rank of major was handicapped in his dealings with officers of rank higher than his own, even though their duties were comparable.

Finally, the record would suggest that the restrictions on travel for the consultant in otolaryngology which prevailed in World War II should not prevail in the event of another war.

CHAPTER VI

The Blood Program

Brigadier General Douglas B. Kendrick, Jr., USA

How many thousands of lives were saved in World War II by the use of whole blood and plasma in the management of battle casualties will never be accurately known. The almost blind dependence originally placed on plasma proved erroneous, but this blood component never lost its value as a means of keeping casualties alive until they could be brought to Army medical installations in which whole blood was available. The use of whole blood was, however, the keystone of the arch of resuscitation, and resuscitation was, in turn, the keystone of all surgery.

In World War I, men died without surgery because the means of resuscitation were not available. In World War II, men survived because they were operated on, but the fundamental reason for their survival was that they lived or, more correctly, were kept alive until they were fit to be operated on. They were kept alive by plasma until they could be given whole blood. They were resuscitated—which means, literally, brought back to life—by whole blood, which made operation possible. Very often they were kept alive during operation by the continued use of whole blood. Finally, many times, their recovery after operation was expedited by the use of whole blood, even if it was not again necessary to keep them alive.

There is no exaggeration in any of these statements, sweeping though they may be. They are generalizations, it is true, but they present the correct picture of how surgery was made possible in World War II and how it saved the lives of thousands of soldiers who otherwise would have died.

Since the importance of whole blood in resuscitation was realized almost from the beginning by all the personnel and agencies connected with the program, it is difficult to understand why its procurement, distribution, and employment got off to such a slow start in World War II. Any explanation must be a mixture of opinion and fact. It seems fair to say that the chief reason was that overenthusiasm for the potentialities of plasma as an almost complete blood substitute tended to minimize the consideration which might otherwise have been given to the development of methods for making the use of whole blood practical.

Before World War II began, as will be pointed out later (p. 141), there had been only one practical demonstration, by DeGowin and his associates [1] at

[1] DeGowin, E. L., and Hardin, R. C.: A Plan for Collection, Transportation, and Administration of Whole Blood and of Plasma in Warfare. War Med. 1: 326–341, May 1941.

the State University of Iowa College of Medicine, Iowa City, of the possibility of storing whole blood for any extended periods of time and shipping it over considerable distances. More important, as the discussion at the first meeting of the Committee on Shock and Transfusions, Division of Medical Sciences, National Research Council,[2] clearly shows, the feasibility of such a project had to be developed and accepted as a concept. This consideration was much more important than the existing lack of means to store blood and to transport it safely over long distances. It was even more important, for that matter, than the fact that an oversea air transportation system had not yet been developed when World War II began.

Finally, those in charge of the blood program, while they clearly understood that large amounts of whole blood would be required in the management of battle casualties, did not begin to make their voices heard until 1943. It was not until the end of that year that strong, constructive, concrete recommendations began to be made, and it was not until the following year, 2 months after D-day in the European theater, that these recommendations were finally accepted and implemented in the Office of the Surgeon General.

The whole program for the provision of blood and blood substitutes in World War II was a superb national effort. Both Federal and civilian agencies participated in it, but its lifeline was provided by the millions of volunteer donors who gave their blood to supply blood, plasma, and other blood substitutes for the Army, including the Army Air Forces, and the Navy. Over the period of the conflict, total bleedings of these volunteer donors numbered 13,326,242.[3] This gigantic pool of what was truly a lifegiving fluid contributed immeasurably, intangibly as well as tangibly, to the successful outcome of the war. It was a visible manifestation of the loyalty to their country of the individual donors who gave their blood and who thus demonstrated their belief in the way of life for which the United States of America stands.

BLOOD AND BLOOD SUBSTITUTES AT THE BEGINNING OF WORLD WAR II

Historical Note

The need for transfusions of whole blood in casualties with battle-incurred wounds had been recognized in World War I, and the effectiveness of this method of combating shock had been demonstrated by Robertson[4] and others, as early as 1916. Blood transfusion increased in popularity as the war progressed, but for practical reasons it was never used routinely, and it was attended with a number of disadvantages and risks.

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[2] Minutes, meeting of Committee on Shock and Transfusions, Division of Medical Sciences, National Research Council, 31 May 1940.

[3] Robinson, G. Canby. American Red Cross Blood Donor Service During World War II: Its Organization and Operation. Washington: The American National Red Cross, 1 July 1946.

[4] Robertson, L. Bruce: The Transfusion of Whole Blood. A Suggestion for Its More Frequent Employment in War Surgery. Brit. M J. 2: 38–40. 8 July 1916

The use of blood plasma as a substitute for whole blood was also proposed in World War I. In March 1918, Ward[5] pointed out that the administration of citrated plasma, which could be preserved easily and injected safely, would meet the need of casualties in shock from hemorrhage, who, in his opinion, required replacement of depleted fluid more than replacement of lost hemoglobin. He also noted that the risk of hemolysis of the donor's corpuscles by the recipient's plasma would thus be eliminated. Earlier that year, Rous and Wilson[6] had advanced the same theory and had reported the experimental use of plasma for resuscitation of animals after massive blood loss.

Later in 1918, Mann[7] proposed that blood serum be used for the treatment of surgical shock, on the basis of the good results which he had obtained with it in experimental shock. He also suggested that homologous serum might be of value in circumstances in which serum could be stored and whole blood could not be obtained.

Interval Between the World Wars

It required the experience of World War II to establish the efficacy of large volumes of blood, administered rapidly, in the resuscitation of exsanguinated casualties and their conversion to acceptable candidates for surgery. The interval between this experience and the tentative experience of World War I was characterized by a number of developments, which may be briefly summarized as follows:

1. Outstanding contributions to the literature of shock were made during this period by Cannon,[8] Parsons and Phemister,[9] Moon,[10] and Blalock,[11] among others. As time passed, Cannon's original theory, that shock is produced by the absorption of toxic materials from the site of injury, was supplanted by the work of Parsons and Phemister, and later by the work of Blalock. These observers demonstrated that shock is the result of loss of fluid locally, at the site of injury, and that the local loss causes, in turn, a significant decrease in the circulating blood volume. By 1940, the concept had been generally accepted that the basis of shock is a decrease in the circulating blood volume, as just stated, or a discrepancy between the blood volume and the volume capacity of the vascular system, or a combination of these two alterations in the normal physiologic processes, with resulting tissue anoxia,

[5] Ward, G. R.: Transfusion of Plasma. Correspondence. Brit. M.J. 1: 301, 9 Mar. 1918.

[6] Rous, P., and Wilson, G. W.: Fluid Substitutes for Transfusion After Hemorrhage. First Communication. J.A.M.A. 70: 219–222, 26 Jan. 1918.

[7] Mann, F. C.: Further Experimental Study of Surgical Shock. J.A.M.A. 71: 1184–1188, 12 Oct. 1918.

[8] Cannon, Walter B.: Traumatic Shock. New York and London: D. Appleton and Company, 1923.

[9] Parsons, E., and Phemister, D. B.: Hemorrhage and "Shock" in Traumatized Limbs. An Experimental Study. Surg., Gynec. & Obst. 51: 196–207, August 1930.

[10] Moon, Virgil H.: Shock and Related Capillary Phenomena. New York: Oxford University Press, 1938.

[11] Blalock, Alfred: Principles of Surgical Care Shock and Other Problems. St. Louis: The C. V. Mosby Company, 1940.

which, if not reversed, leads to death. It is upon these concepts that the modern use of whole blood in the management of shock is based. Strumia and his associates,[12] whose first work was done with intravenous serum in the treatment of severe infections, later substituted plasma for serum because of its greater simplicity of preparation and the greater yield from the same amount of whole blood. In 1935 Filatov and Kartasevskij [13] reported the use of intravenous plasma as a hemostatic agent, and in the same year Heinatz and Sokolow [14] used plasma in the treatment of hemolytic shock. The following year, Elliott [15] suggested that untyped serum and plasma be used when transfusion was indicated in the management of surgical, traumatic, and obstetric shock. His reasoning was that the maintenance of osmotic pressure is a function of the plasma proteins and that the need for replacing lost blood volume is more important than the need for replacing red blood cells. During the next 2 or 3 years, a number of other observers also published reports on the use of plasma in the management of shock and described techniques for its preparation in the liquid, frozen, and dried states.

2. The considerable amount of work on the fractionation of plasma done by Cohn [16] and his associates led to the use of serum albumin for the treatment of shock.

BEGINNINGS OF THE BLOOD AND BLOOD SUBSTITUTES PROGRAM

When it became increasingly evident, early in 1940, that the United States might eventually become involved in the hostilities in Europe and that the Medical Department of the Army might be called upon to care for mass casualties resulting from enemy action, the major problem which confronted the Department was the development of an improved method of treating traumatic shock.

At this time (the spring of 1940), the situation with respect to the use of blood and blood substitutes in the management of shock may be summarized as follows:

1. The use of type-specific whole blood had become a practical procedure in civilian hospitals, but it was still given in only small amounts and, as a rule, heroically; that is, transfusion was still being resorted to chiefly in critically, or at least gravely, ill patients, whose status was truly desperate.

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[12] (1) Strumia, M. M., Wagner, J. A., and Monaghan, J. F.: The Intravenous Use of Serum and Plasma, Fresh and Preserved. Ann. Surg. 111: 623–629, April 1940. (2) Strumia, M. M., and McGraw, J. J.: The Development of Plasma Preparations for Transfusions. Ann. Int. Med. 15. 80–88, July 1941.

[13] Filatov, A., and Kartasevskij, N. G.: Die Transfusion von menschlichem Blutplasma als blutstillendes Mittel. Zentralbl. f. Chir. 62: 441–445, 23 Feb. 1935.

[14] Heinatz, S. W., and Sokolow, N. I.: Plasmatransfusion als Methode der Wahl in der Behandlung des hämolytischen Schocks. Zentralbl. f. Chir. 62: 1753–1755, 27 July 1935.

[15] Elliott, J.: A Preliminary Report of a New Method of Blood Transfusion. South. Med. & Surg. 98: 643–645, December 1936.

[16] Cohn, E. J.: Properties and Functions of the Plasma Proteins, With a Consideration of the Methods for Their Separation and Purification. Chem. Rev. 28: 395–417, April 1941.

The concept that blood should be used liberally to prevent the development of situations of desperation was still very far off.

2. Direct techniques of transfusion were still in frequent use, though a gradual shift to indirect techniques was occurring. The changeover, however, was slow for two reasons; namely, lack of satisfactory equipment and the reactions credited to the use of citrate as a preservative fluid.

3. Reaction rates from blood transfusions were still sufficiently high to alarm even the most enthusiastic proponents of the liberal use of whole blood There was almost complete ignorance concerning pyrogenic reactions, which were the most frequent variety and which occurred most insidiously.

4. The use of blood plasma was still chiefly experimental.

5. The use of blood serum (the liquid portion of the blood separated from the solid elements after clotting) was also almost entirely experimental, its administration at this time being advocated by only a few pioneers.

6. The use of serum albumin had not yet been developed.

Program at the Army Medical School

The first steps in the solution of the problem were taken by Col. (later Brig. Gen.) Charles C. Hillman, MC, Chief, Professional Service Division, Office of the Surgeon General. Colonel Hillman's first action was to request Col. (later Brig. Gen.) George R. Callender, MC, Commandant, Army Medical School, to organize a blood research branch in the Department of Surgical Physiology at the school.

This department had been set up in 1936 by Capt. (later Col.) Sam F. Seeley, MC, but, in 1938, when Captain Seeley had been transferred elsewhere, it had ceased to function, after 2 years of very active operation. Capt. (later Col.) Douglas B. Kendrick, MC, (fig. 23) was selected to head the reactivated department because of his earlier training.[17] The original personnel consisted of himself and an enlisted man who served as his technical assistant.

Program of the National Research Council

At the time that Colonel Hillman requested Colonel Callender to set up a blood research program at the Army Medical School, he also, acting for The

[17] During a civilian surgical residency at Grady Hospital, in Atlanta, under Dr. Daniel C. Elkin, Captain Kendrick had had a considerable experience in the large amount of traumatic surgery handled at that institution, with its attendant problems, including shock. He had also served under Dr. Fred Rudder, who was greatly interested in the use of whole blood in shock and who had devised an ingenious apparatus for direct transfusion.

After his service at Grady Hospital, Captain Kendrick entered the Army Medical Corps and, because of his previous experience, was sent for a year to the Institute of Experimental Medicine at the Mayo Clinic, Rochester, Minn., where he worked on shock, replacement fluids, gas gangrene, and special uses of the sulfonamides. He also did work in anesthesia under Dr. John S. Lundy. The plan had been that on Captain Kendrick's return to the Army Medical School he should continue Captain Seeley's work Funds for research, however, proved so inadequate that this plan could not be carried out, and he was therefore assigned to the orthopedic service, Walter Reed General Hospital, and was on this service when, at Colonel Hillman's request, the Department of Surgical Physiology at the Army Medical School was reactivated, with research in blood and blood substitutes as its chief objective.—J. B. C., Jr.



FIGURE 23.—Col. Douglas B. Kendrick, MC, Chief, Division of Surgical Physiology, Army Medical School, Walter Reed General Hospital.

Surgeon General, requested the Division of Medical Sciences, National Research Council, to assemble a civilian committee which could act informally, in an advisory capacity, to the Surgeons General of the Army and the Navy. The Committee on Shock and Transfusions, which was appointed in response to this request, held its first meeting on 31 May 1940.[18] Dr. Walter B. Cannon, Professor of Physiology, Harvard Medical School, Boston, Mass., served as chairman of the meeting, and the Subcommittee on Blood Substitutes was appointed with Dr. Cyrus C. Sturgis, Professor of Internal Medicine, University of Michigan Medical School, Ann Arbor, Mich., as chairman. In April 1941, Dr. Sturgis was succeeded by Dr. Robert F. Loeb, Professor of Medicine at the same school.[19]

Other members of the Subcommittee were Dr. Elmer L. DeGowin, who served as secretary, Dr. Cornelius P. Rhoads, Dr. O. H. Robertson, Dr. John Scudder, Dr. Max M. Strumia, and Dr. Owen H. Wangensteen. The initial meeting, held on 19 April 1941, was also attended by Dr. Lewis H. Weed,

[18] See footnote 2, p. 122.

[19] Minutes, meeting of Subcommittee on Blood Substitutes, Division of Medical Sciences, National Research Council, 19 Apr. 1941.

Chairman, Executive Committee, Division of Medical Sciences, National Research Council; Dr. Milton V. Veldee, Chief, Biologics Control Laboratory, National Institute of Health; Lt. Comdr. Lloyd R. Newhouser, MC, USN; and Captain Kendrick. All the members of the Subcommittee had previously done outstanding work in the field of blood and blood substitutes.

Program in the Office of the Surgeon General

Until 1942, the primary responsibility for the program on blood and blood substitutes rested with the Blood Research Division, Army Medical School. In that year, the responsibility for the program in the Office of the Surgeon General was assigned to the Surgical Consultants Division. At the same time, Lt. Col. B. Noland Carter, MC, assistant chief of the division, was made responsible for all matters concerning fluid replacement in shocked patients. On 24 November 1943, the Transfusion Branch was created in the Surgical Consultants Division, with Colonel Carter as chief and Maj. (later Lt. Col.) Frederic N. Schwartz, MAC, as operations officer.[20] The Transfusion Branch was eventually given the entire responsibility for the blood procurement program up to the point at which the blood was placed on aircraft for oversea shipment.

For a 3-month period in 1943, Col. Charles F. Shook, MC, had served as special representative to The Surgeon General on blood and plasma transfusions. When the Transfusion Branch was created, Colonel Kendrick assumed these duties. In November 1944, when Colonel Kendrick was transferred to the Pacific, he was succeeded by Maj. John J. McGraw, Jr., MC. The duties of the special representative to The Surgeon General on blood and plasma transfusions were to formulate policy, to estimate blood requirements, and to evaluate the efficiency and suitability of apparatus, equipment, and technical procedures. Major Schwartz handled administration, supply, and personnel. Recommendations were channeled through Colonel Carter.

In all his connection with the blood program, Colonel Kendrick served as chief of the blood research program at the Army Medical School. When he was assigned to the Office of the Surgeon General in 1943, as special representative on blood and plasma transfusions, it seemed more advisable for him to continue to operate under the table of allowances at the Army Medical School, in order to provide free access to the research facilities still needed in the program. During the entire war, there was always the closest possible cooperation between the school and the Office of the Surgeon General. Both General Callender at the school and General Hillman in the Office of the Surgeon General gave unlimited support in all Colonel Kendrick's activities, and all matters dealing with blood, shock, or resuscitation were automatically referred to Colonel Kendrick.

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[20] Annual Report, Surgery Division, Surgeon General's Office, Fiscal Year 1944.

Cooperation With the Navy Program

In April 1940, shortly after Captain Kendrick had been assigned to the Division of Surgical Physiology at the Army Medical School, Lt. Comdr. Lloyd R. Newhouser, MC, USN, was assigned to the National Naval Medical Center, Bethesda, Md., with duties very similar to Captain Kendrick's. The two officers encountered each other in the course of their work, and, since they were trying to accomplish the same results, it seemed only sensible to pool their efforts, which they did until late 1944, when both were transferred to oversea duty. The collaboration, while entirely unofficial, was approved and encouraged by the superior officers in both services and proved extremely fruitful.

Commander Newhouser and Colonel Kendrick kept themselves closely informed of each other's plans and progress. As a result, many items were standardized by both the Army and the Navy and most orders were placed with a consideration of joint needs. The intimate liaison between the Army and the Navy was an important factor in the maintenance of a smoothly running program for the procurement of plasma, albumin, and, later, whole blood. It was out of this informal arrangement that formal plans were eventually consummated for the Navy to assume the responsibility of flying blood to the Pacific.

IMMEDIATE PROBLEMS IN 1940

Among the major problems to be solved when the blood and blood substitutes program was set up at the Army Medical School in the spring of 1940 were the following:

1. How could blood for transfusion be provided in sufficient quantities for the large numbers of casualties to be expected in modern warfare?
2. How could blood be safely stored?
3. How could the current high incidence of transfusion reactions be reduced?
4. What type of equipment could be developed to provide sterile, pyrogen-free, easily dispensable transfusion fluids?
5. What types of blood substitutes could be provided? How could they be stored safely? How could they be used in the field?
6. How could the medical profession, which was still, for the most part, highly skeptical on these various points, be convinced of the safety and desirability of employing whole blood and blood substitutes in the management of trauma?

The first step in the solution of these problems was to collect as much information as possible on the following points:

1. The clinical use of whole blood.
2. The availability of blood plasma and its clinical use.

3. The processing of fluids for intravenous use.

4. The development, manufacture, and testing of equipment for the administration of fluids intravenously.

The literature was surveyed and analyzed, and a large collection of reprints was built up. At this time, the literature on shock was voluminous, but the literature on plasma and other blood substitutes was rather scanty, and contributions on liquid plasma were just beginning to appear.

Information on these subjects was also collected, by personal visits, from the following sources:

Dr. (later Capt., MC) John Elliott, pathologist at the Cabarrus Hospital, Salisbury, N.C., who had developed a method of processing sterile, pyrogen-free plasma in liquid form. When Dr. Elliott later entered the U.S. Army, he was assigned to the Army Medical School, where he instructed personnel in the processing of the liquid plasma used in Zone of Interior hospitals. He also contributed to the development of the vacuum bottle manufactured by the Baxter Company and used, with certain modifications, for both plasma and whole blood during the war.

Dr. Max M. Strumia, pathologist at the Bryn Mawr Hospital, whose work on dried plasma has already been mentioned.

Dr. John Reichel, of the Reichel Laboratories, Kimberton, Pa., who had worked with Dr. Strumia on the development of equipment for drying plasma.

Dr. Stuart Mudd, Professor of Bacteriology, School of Medicine, University of Pennsylvania, Philadelphia, Pa., and Dr. Earl W. Flosdorf, an experienced refrigeration engineer who had worked with Doctor Mudd as his research assistant on the preparation of serum and on freezing and drying plasma.

Information was also secured from Sharp & Dohme, a firm which had long been interested in the preparation of antisera and other immunizing agents. This company had done considerable work with typhoid and other vaccines, and, with the help of Dr. John Reichel, had pioneered in the development of vacuum-drying equipment.

Many of the manufacturers of intravenous solutions and blood transfusion apparatus both at this time and later worked in close cooperation with the Blood Research Division, Army Medical School, in the development of a closed system for the collection of blood to insure sterile, pyrogen-free storage. When the blood program was more fully developed, all the laboratories of the commercial pharmaceutical houses also worked in close cooperation with each other, exchanging information and reporting problems and their solutions. Sharp & Dohme, which held many patents on various drying processes, offered the use of these patents without charge to the other laboratories working on plasma for use in the Armed Forces during the war emergency.

PLASMA PROGRAM

Dried Plasma

Development of the plasma program began with the distribution, for testing purposes, of dried plasma prepared in Dr. Strumia's laboratory at the Bryn Mawr Hospital to the Army and Navy Medical Schools and to members of the Subcommittee on Blood Substitutes, National Research Council. Blood for this program was collected by the Southwestern Pennsylvania Chapter, American Red Cross (p. 135). The dried plasma proved both safe and effective, and on 19 April 1941 the Subcommittee recommended that either frozen or dried plasma be employed as a blood substitute in the treatment of shock.

This recommendation was accepted by the Armed Forces for the following reasons:

1. Supplying whole blood to the Armed Forces in the quantities likely to be needed, together with the safe storage and transportation of the blood, presented logistic problems of enormous proportions which could not be solved in the light of either the knowledge possessed or the facilities available in 1940–41. Preservative solutions which would permit long storage periods were just being developed. Investigations on thoroughly dependable, avid grouping sera were in their early stages. The development of adequate equipment for the collection, storage, and dispensing of whole blood was in its infancy. Refrigeration equipment for use in the field under varying conditions of heat, cold, and humidity had not yet been manufactured. Finally, an airlift capable of delivering blood to the far reaches of the battlefront was still almost 3 years away.

2. Plasma is a homologous protein fluid with the osmotic equivalent of blood. Separated from its cellular components, it can be frozen and dried to less than 1-percent moisture content. In this state, it can be packaged under vacuum and preserved for years, without refrigeration and without being affected by extremes of heat and cold.

3. Plasma can be administered without typing or cross-matching.

4. The use of plasma is attended with a very low incidence of reactions. When it first began to be distributed commercially, each package contained a questionnaire to be filled out and returned to the Army Medical School after the plasma had been administered. The reports on 9,161 plasma transfusions given in oversea hospitals showed only 249 pyrogenic reactions (2.7 percent) and only 106 allergic reactions (1.2 percent). These rates corresponded with those reported from hospitals in the Zone of Interior. All the reported reactions were mild.

5. The equipment necessary for the reconstitution and intravenous administration of dried plasma could be incorporated in a small kit, which could be made available under almost all conditions of war.

6. The yield of plasma was greater—from 15 to 20 cc. more per pint of blood—than the yield of serum.

7. Most important of all, in the light of the immediate needs, plasma could be easily and safely produced commercially in large quantities.

These inherent organic characteristics of plasma, particularly the ease with which it could be manufactured, stored, and transported, obviously made it a practical and desirable agent. The reasons for its selection in 1941, while not fully explaining the failure to supply whole blood to field units at this time, did take cognizance of obstacles which went far toward discouraging even the most ardent advocates of whole blood as a feasible replacement fluid in Zone of Interior hospitals. These reasons were considerably more valid in the recommendation of plasma as a feasible and practical agent for blood replacement in oversea hospitals.

Packaging.—As soon as the decision was made to employ dried plasma as a blood substitute, it became necessary to standardize a method of packaging it. The Blood Research Division of the Army Medical School cooperated with the Subcommittee on Blood Substitutes, National Research Council, and with the National Institute of Health to devise a standard package, which could be used by both the Army and the Navy.

The package which was eventually developed (fig. 24) contained a waterproof fiberboard box; a rubber-stoppered bottle of dried plasma, evacuated to 28 inches of vacuum, with the sterile, pyrogen-free equipment to administer it, contained in a sealed tin can evacuated to 26 inches of vacuum; and a rubber-stoppered bottle of distilled water, with the equipment necessary to combine it with the plasma, contained in a tin can.

After some changes in the initial specifications, this package, which was first produced by commercial laboratories in 1941, was used with satisfaction throughout the war.

The first packages which were put up contained 250 cc. of dried plasma, together with the appropriate amount of diluent fluid. Late in 1943, the amount of plasma in each package was increased to 500 cc. The change was made for the following reasons: (1) The realization, gained with increasing experience, that the average wounded man required at least 500 cc. of plasma for resuscitation and (2) the increasing necessity for conserving scarce materials, such as rubber tubing and needles, and for utilizing scarce shipping space to the fullest extent.

The new program created one major problem. For physical reasons, since the speed of drying was partly a function of the surface area of plasma exposed and the thickness of the plasma shell, it was found difficult to dry 500 cc. of plasma in a bottle not much larger than the bottle designed to contain half that amount. Within a short time, however, this problem was solved in commercial production, as it had been solved in the laboratory.

By the time the change in packaging was made, medical officers had fully realized the need for larger quantities of plasma and were delighted to have



FIGURE 24.—Preparation for plasma transfusion. A, Army-Navy plasma package (250 cc.). B, Contents of package (dried plasma and sterile diluent). C, Reconstitution of plasma. D, Reconstituted plasma ready for injection.

them provided so conveniently. The larger package saved 50 percent of the rubber tubes, needles, and other material necessary when the plasma was put up in smaller amounts, and the savings were tremendous because such enormous quantities of plasma had to be provided. Thousands of feet of rubber tubing were conserved, for instance; this was a significant saving, since rubber was then in very short supply. The larger package also provided, in about a third more of the space previously used, twice the amount of plasma previously provided, this was an important consideration in view of the shortages in shipping space.

Production.—In all, 10,299,470 pints of the 13,326,242 pints of blood collected by the American Red Cross in its blood procurement program were processed into dried plasma.[21] More than 3,000,000 packages were put up containing 250 cc. of dried plasma and more than 3,000,000 packages containing 500 cc.

Homologous serum jaundice.—In the light of the postwar incidence of homologous serum jaundice attributable to plasma transfusions, it is important to emphasize certain facts about the wartime use of plasma. Although plasma was used in enormous quantities for battle casualties, it was not until late in 1945 that pooled plasma was indicted as the vehicle for the causative agent of this disease. Numerous cases of jaundice had occurred previously in military personnel after plasma transfusions, but the causative connection between the jaundice and the transfusion was not immediately realized. In retrospect, what happened is clear. A single transfusion of blood is likely to cause jaundice in only a small percentage of the recipients. When, however, blood is pooled, as it is when plasma is processed, the chances of contracting jaundice are correspondingly increased. Furthermore, whereas only 8 pints of blood were pooled in the preparation of the liquid plasma used in Zone of Interior hospitals, amounts as large as 50 pints were pooled in the early stages of the dried plasma program for overseas, and later, in 1944–45, even larger amounts were frequently pooled. The relation of these various facts to the development of jaundice is now perfectly evident, but the causal sequence was not appreciated until the war had ended.

Liquid Plasma

One of the first projects of the Blood Research Division at the Army Medical School was an investigation of the possibility of supplying liquid plasma to hospitals in the Zone of Interior. Experience in a number of civilian hospitals had indicated that the plan could be operated successfully, though, because of the high rate of contamination, the collection and processing of plasma in this form in the United States for the British had not proved practical. The explanation was the unsatisfactory equipment used. The Blood-for-Britain experience demonstrated that a completely closed, sterile system was necessary for the collection and processing of plasma, and, unfortunate though it was, it undoubtedly saved the Army program from mistakes which otherwise certainly would have been made.

The first liquid plasma for Army use was prepared in December 1940 in the small blood-donor center set up at the Army Medical School. An average of 6 donors a day were secured by phoning persons whose names were provided, in groups of 10, by the American Red Cross. The calls were made at night, and the donors were asked to report the following day.

[21] See footnote 3, p. 122.

On 1 June 1941, a bleeding center was opened in Washington, D.C., as an Army-Navy project. The American Red Cross procured the donors and operated the center with technical help furnished by the Army Medical School and the Navy. The blood secured was divided between the Army and the Navy, and the Army share was processed into liquid plasma at the Army Medical School. In January 1942, regular shipments of liquid plasma to a number of Zone of Interior hospitals were begun.

The experimental program proved so successful from the outset that plans were made to supply all Zone of Interior hospitals with liquid plasma. Several medical officers and a number of enlisted technicians were attached to the Division of Surgical Physiology, Army Medical School, for training, and were then sent out to establish five other centers in various parts of the country. These centers supplied the requirements of the hospitals in adjacent service commands. In 1943, four of the six centers were converted to bleeding centers for dried plasma and albumin, leaving the other two centers (in Washington, D.C., and Denver, Colo.) to collect blood and process it into liquid plasma for all Zone of Interior hospitals.

There were no confirmed reports of the distribution of contaminated plasma to any hospital, and the incidence of transfusion reactions was small.

Of the 310,135 blood donations delivered from bleeding centers to military medical hospitals, 295,200 were converted to liquid plasma for utilization in the military services in the Zone of Interior. The remainder were used for whole blood transfusions at hospitals near the centers and for dried plasma prepared at the Army Medical School for use by Army Air Force units in the Zone of Interior.

Participating Agents in the Plasma Program

Commercial laboratories.—The processing of whole blood into dried plasma for the Armed Forces was a function of the large biologic and pharmaceutical laboratories. The first contract, for 15,000 packages, was made with Sharp & Dohme, because of the previous experience of this firm in allied fields. The first plasma was processed commercially in February 1941, and, before the declaration of war on 8 December 1941, three other laboratories had received contracts. Eventually, nine laboratories were processing plasma for the Armed Forces, as follows:

Sharp & Dohme, beginning 4 February 1941.

Eli Lilly & Co., beginning 1 October 1941.

Lederle Laboratories (Division of American Cyanamid Co.), beginning 14 October 1941.

Reichel Laboratory (later, Reichel Division of Wyeth, Inc.), beginning 18 November 1941.

Ben Venue Laboratories, beginning 10 January 1942.

Cutter Laboratories, beginning 12 January 1942.
Hyland Laboratories, beginning 13 May 1942.
Parke, Davis & Co., beginning 29 June 1942.

National Institute of Health.—The National Institute of Health exercised no control over the preparation of blood substitutes until Cohn's[22] fractionation of plasma proteins and the preparation of dried plasma. Up to that time, no question of interstate commerce was involved. With these accomplishments, however, the products became biologics, over which manufacture, storage, and utilization this agency had to exercise control. To produce and sell biologics, including serum, albumin, and dried plasma, a license from the National Institute of Health was required.

Close liaison was maintained by the Army and Navy throughout the war with Dr. Milton V. Veldee, Chief, Biologics Control Laboratory, National Institute of Health. Minimum specifications were prepared for the processing and packaging of plasma and the products of plasma fractionation. All modifications in both apparatus and techniques for the dried plasma program were made only after consultation with, and approval by, Dr. Veldee, Commander Newhouser, and Colonel Kendrick. Representatives of the National Institute of Health frequently visited the commercial laboratories, aiding them in the setting up of routine techniques for the preparation of dried plasma and assisting them in the solution of special problems.

American Red Cross.—When the decision was made to use commercially dried plasma as a blood substitute in the war emergency, the American Red Cross was selected as the collecting agency. Several of this agency's chapters had had some previous experience in the procurement of blood donors in cooperation with several civilian hospitals. Further experience had been gained in the Blood-for-Britain Program conducted in New York City from August 1940 to January 1941.

The first phase of the national program to secure blood for dried plasma was inaugurated by the Southeastern Pennsylvania Chapter in Philadelphia, in September 1940. This chapter, as has been mentioned, procured the donors for the study of the preparation and use of dried plasma then being conducted by Dr. Strumia, under the auspices of the Subcommittee on Blood Substitutes, Division of Medical Sciences, National Research Council.

The formal request that the American Red Cross undertake the responsibility of collecting blood for the dried plasma program was made on 8 January 1941 by the Surgeons General of the Army and the Navy, after extended discussions. The program was formally inaugurated on 4 February 1941, in New York City, and was continued until 15 September 1945. In all, 35 chapters participated.

The initial phases of the program were directed and supervised by Dr. William DeKleine, Medical Director, American Red Cross. In July 1941, Dr.

[22] See footnote 16, p. 124.

G. Canby Robinson was appointed National Director for the American Red Cross Blood Donor Service, and Dr. (later Major, MC) Earl S. Taylor was appointed technical director. Major Taylor had worked in the blood bank at Presbyterian Hospital, New York, N.Y., and therefore came to these duties with a wide experience in the blood bank field.

The processing of donors and the collection of blood under the rigid technical controls imposed by the National Institute of Health was an operation of real magnitude. The Red Cross accepted the responsibility of establishing donor centers, recruiting donors, providing administrative personnel, and also providing part of the professional personnel. Because of the immensity of the undertaking, however, and the military need for physicians, it eventually became necessary for the Red Cross to ask help from the Army and the Navy for the operation of their 35 blood centers and their associated mobile units. At one period of the program, the services of 127 physicians were necessary.

The 60 medical officers supplied by the Army were assigned to the Army Medical Purchasing Office and were placed under the operational control of the Office of the Surgeon General. They were directly supervised by Major Taylor; for practical reasons, after he had been commissioned in the Medical Corps, he retained his position in the Red Cross, so that medical officers working in the blood collection centers would be under the supervision of a medical officer. Essential as was the work of these centers, it was neither an interesting nor a desirable assignment. Attempts were made to rotate the officers assigned to the centers, but they were not particularly successful, and many of the officers remained in an assignment for 2 or more years.

During 1940 and 1941, before the entry of the United States into the war, the response of the public to appeals for donations of blood was not encouraging. After the attack on Pearl Harbor, on 7 December 1941, the number of donors increased sharply, and it became necessary to schedule appointments and control the donations with due regard for the facilities available for drying plasma; these facilities were developed as rapidly as the necessary equipment could be provided for them.

As the war progressed and the numbers of casualties increased, calls for blood donors increased correspondingly. In 1944, more than 5,000,000 pints of blood were collected, and donations averaged 100,000 pints per week. After blood began to be flown to the Pacific areas, in November 1944 (p. 158), appeals for donors were regulated according to the needs reported by the officer on Guam who was in charge of the program.

National Research Council.—On 7 January 1941, at the same time that Maj. Gen. James C. Magee, The Surgeon General of the Army, requested the American Red Cross to initiate a blood donor program for supplying plasma for the Armed Forces, he addressed a letter to Dr. Lewis H. Weed, Chairman, Executive Committee, Division of Medical Sciences, National Research Council, in which he requested that the Division of Medical Sciences undertake general supervision of the professional services involved in this project. Dr. Weed

replied on 9 January 1941 that the Division of Medical Sciences would gladly undertake the responsibility and would do everything possible to make the cooperation effective. The Division's personnel rendered invaluable services throughout the period of the emergency.

SERUM PROGRAM

In the early days of the Army blood program, there was considerable discussion concerning the possible advantages of human serum over plasma. Serum has a number of advantages, the chief advantage being that it does not contain fibrinogen, which is easily precipitated from liquid plasma. On the other hand, plasma, from the technical standpoint, is somewhat easier to prepare, and the yield from a given portion of blood is somewhat larger than the yield of serum. Reports that human serum had given adverse reactions in some instances, particularly when it was very fresh, were not confirmed in a series of 24 cases in which it was tested clinically. The number of cases was too small to warrant conclusions, but the satisfactory results cast considerable doubt on the risk of reactions after its use.

As a matter of fact, the advantages of plasma and serum were admittedly about equal, but the National Research Council chose to recommend the use of plasma for the Armed Forces, and the Army and the Navy chose to accept the recommendation for the practical reasons already listed (p. 130), chiefly the greater yield of plasma per pint of blood and the fact that it could be produced safely and readily, in the large quantities necessary, by commercial houses. In addition, the widest previous experience had been with plasma, and the urgency of the situation did not permit delay for further testing before the initiation of mass production.

The results achieved by the use of plasma fully justified its selection, though the Canadian Army, in which serum was used, had equally good results with that blood substitute.

HUMAN SERUM ALBUMIN PROGRAM

Early discussions of the Committee on Shock and Transfusions, Division of Medical Sciences, National Research Council, had dealt with the possible use of both bovine and human albumin in shock. It had been hoped that bovine albumin, which could be procured in almost unlimited quantities from abattoirs all over the country, might prove an effective blood substitute. The first studies were encouraging, but later investigations showed that this substance was not entirely safe for intravenous use, and its employment did not progress beyond the experimental stage.

For a number of years before the war, Dr. Edwin J. Cohn, Professor of Physical Chemistry at Harvard University, and his associates had been working on methods for the fractionation of plasma proteins. Early in 1941,

both Cohn [23] and Janeway [24] suggested the possibility of using human serum albumin in the treatment of shock and hypoproteinemia. After adequate testing, this substance, in contrast to the bovine product, was found to be a safe and effective blood substitute. On 5 January 1942, the Conference on Albumin of the National Research Council recommended to the Surgeons General of the Army and the Navy that it be adopted for clinical use and that the Red Cross be requested to add to its program the procurement of donors for the processing of blood into albumin.[25]

The first successful use of human albumin was reported by Major Kendrick.[26] The patient, who had multiple compound fractures, was in serious shock, with a blood pressure of 76/30, when he was admitted to Walter Reed General Hospital in May 1941. The response to therapy was prompt, and within a few hours reduction of all his fractures was possible. In all, albumin was used with excellent results in 87 cases at this hospital. Other tests were carried out at Peter Bent Brigham Hospital, Boston, Mass.; the University of Minnesota Hospital, Minneapolis, Minn.; the Presbyterian Hospital, New York City, N.Y.; and the U.S. Naval Medical Center, Bethesda, Md.

Albumin was dispensed in 25-percent solution in 100 cc. of distilled water. At first, the intrinsic sodium chloride content was allowed to remain in situ. Later, albumin was dispensed salt-free. It was packaged in a glass vial, with a rubber stopper at each end to facilitate its administration (fig. 25).

The small size of the package in which albumin was dispensed led to its selection by the Navy as the preferred blood substitute because of space limitations on destroyers and other small craft. Albumin was also utilized, for the same reason, by the Marines in their island operations in the Pacific. The Army continued to use the standard Army-Navy package of plasma both because of the good results obtained with plasma and because of one of the disadvantages of albumin, the necessity of administering isotonic fluids with it to dehydrated casualties.

The high concentration of albumin in the standard package made its physiologic effect dependent upon the rapidity with which it mobilized interstitial fluid. In a well-hydrated patient, this was not problem; the circulating blood volume was promptly increased, and the intravascular discrepancy characteristic of shock was promptly overcome. In the dehydrated casualty, the problem was different, and, since the majority of wounded soldiers, under the rigorous conditions of combat, were dehydrated, the administration of isotonic fluids along with the albumin was necessary in most cases, even though it was not always practical.

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[23] See footnote 16, p. 124.

[24] Janeway, C. A.: War Medicine, with Special Emphasis on the Use of Blood Substitutes. New England J. Med. 225: 371-381, 4 Sept. 1941.

[25] Minutes, meeting of Conference on Albumin, Division of Medical Sciences, National Research Council, 5 Jan. 1942.

[26] Mudd, Stuart, and Thalhimer, William. Blood Substitutes and Blood Transfusion. Springfield: Charles C. Thomas, 1942, p. 200.

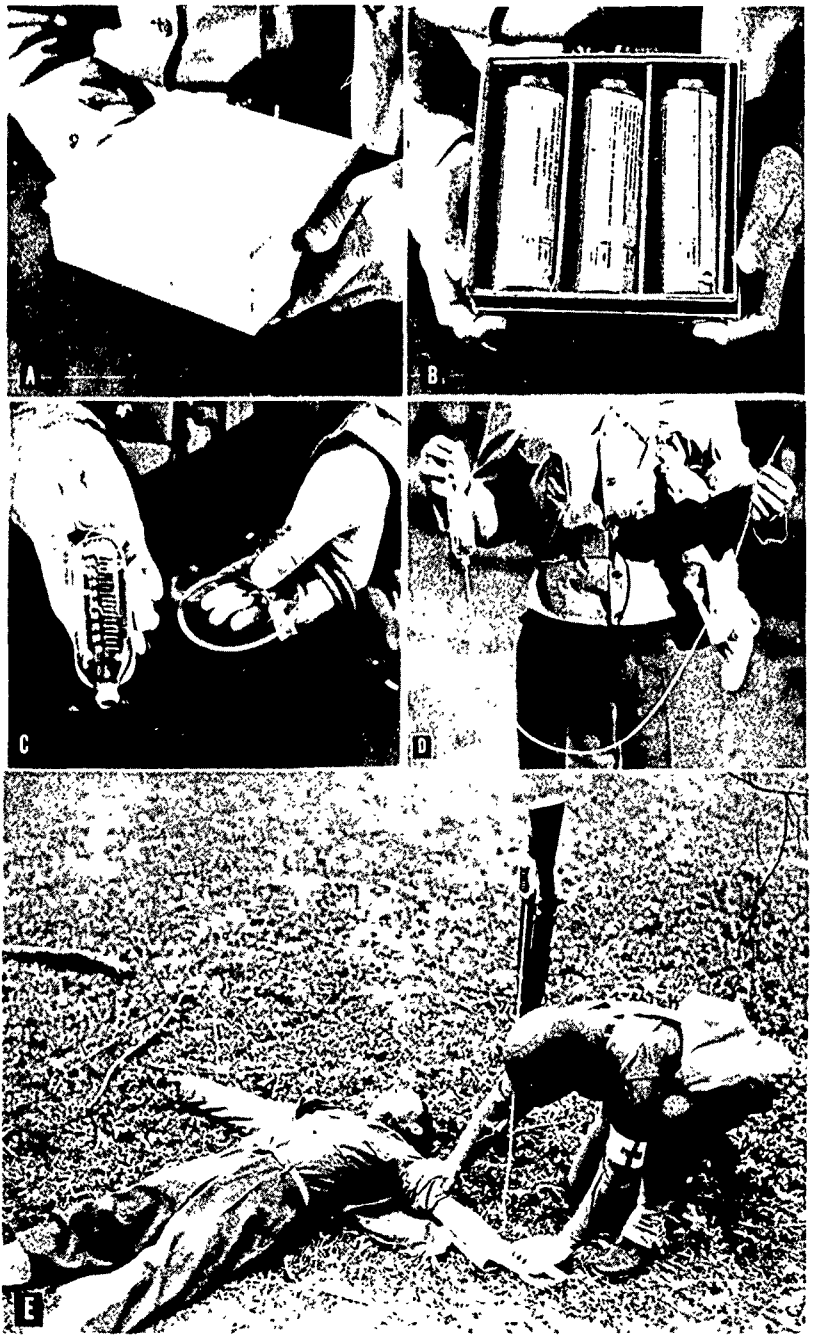


FIGURE 27. Serum albumin transfusion. A. Standard Army-Navy serum albumin package (3 units). B. Contents of package (3 cans of albumin with dispensing equipment for each). C. Double-ended glass vial containing 1 unit of albumin; dispensing set. D. Recipient set connected and ready for use. E. Demonstration of the administration of serum albumin.

Another disadvantage of albumin was that its yield per pint of blood was less than the yield of plasma; 3.2 to 4.0 pints of blood were required for each 100 cc. of albumin, against only 2.4 pints of blood for a 500-cc. unit of plasma.

Albumin, nonetheless, had a number of advantages, as follows:

1. It was stable in solution for protracted periods and over a wide temperature range.

2. It was therefore suitable for use in almost any part of the world in which the Armed Forces might be called upon to operate.

3. It was ready for immediate use, without reconstitution.

4. It occupied little more than a tenth of the space occupied by the standard Army-Navy package of plasma.

5. Later, albumin was proved to be nonicterogenic. It remains stable after heating to 60° C. (140°F.) for 10 hours.

WHOLE BLOOD PROGRAM

Initial Obstacles

As has already been pointed out, the use of plasma as a replacement fluid in shocked casualties was never regarded by knowledgeable authorities as anything more than a compromise which was required by the exigencies of the first months of the emergency. At the first meeting of the Committee on Shock and Transfusions, National Research Council, in May 1940, the question of the possibility or likelihood of improving present methods of preservation of whole blood was raised, as well as the possibility of increasing the safe period Dr. Plass stated that he had already used blood more than 30 days old without any serious reactions, and that he believed that it would be possible, by varying the preservative fluid, to extend the safe period even longer.[27]

In the beginning, however, not a great many observers believed that the extensive use of whole blood would be feasible in forward hospitals in wartime. Very few members of the medical profession, whether military or civilian, foresaw that a situation would arise in which the quantities of whole blood required for the adequate treatment of battle casualties in theaters of operations would necessitate the shipment of blood from the Zone of Interior. Such a contingency seemed particularly unlikely after large amounts of plasma began to be shipped to oversea forces. Experienced physicians, both civilian and military, thought that the brevity of its useful life would make it impractical to ship blood over long distances. Finally, as has already been mentioned, dependable air transport service, a sine qua non of a blood program for oversea troops, was not available in 1940, when the emergency began to develop.

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[27] See footnote 2, p. 122.

An additional reason for skepticism about the practicality of a whole blood program was the lack at this time of a satisfactory preservative solution which would permit the storage of blood for more than a few days. Many believed, in fact, that it would never be practical to store blood in any solution for much longer periods.

Not all authorities accepted this reasoning. Even before the outbreak of the war in 1939, as already mentioned, DeGowin and his associates had transported blood, chilled and kept cold by wet ice, in a solution of their own devising. It had been moved great distances both by land and by air, then returned to the laboratory, checked, and finally used for clinical transfusions without complications.

Although shipment of blood overseas was not seriously considered when the emergency first became evident, investigations were nonetheless continued to develop dependable typing sera, preservative solutions, blood-collecting equipment, and refrigerated shipping containers. The result was that when logistic support for an oversea blood program, in the form of a dependable airlift, did become available, the procurement, safe storage, and safe transportation of blood were no longer impractical.

Early Experience in North Africa

The British, with the outbreak of war in 1939, immediately organized a blood transfusion service, under the full-time direction of Brigadier Lionel E. H. Whitby, RAMC. Experiences in the North African fighting demonstrated the necessity for large quantities of whole blood in the management of wounded casualties, and a blood transfusion unit was promptly organized to supply the British Eighth Army. Several thousand pints of blood were provided to forward hospitals from this unit in Cairo, and when the Eighth Army moved into Italy, its hospitals continued to receive blood from North Africa until the transfusion unit moved to Bari, Italy.

Reports of the British experience in North Africa were made available to the Office of the Surgeon General, U.S. Army, through Col. Frank S. Gillespie, RAMC, British medical liaison officer, who was stationed at the Medical Field Service School, Carlisle Barracks, Pa., during the early months of the war. Colonel Gillespie made every effort, as the British experience progressed, to keep The Surgeon General informed of changing concepts in the care of battle casualties. Colonel Kendrick, The Surgeon General's special representative for blood and transfusion, was exceptionally fortunate in having his complete cooperation and support at a time when medical intelligence was relatively limited.

The whole British experience in North Africa proved that plasma was not enough, although extremely valuable, in the provision of temporary circulatory support for patients who had suffered multiple extensive wounds, accompanied by massive hemorrhage, from mortars, high explosives, and land-

mines. Whole blood, which had the oxygen-carrying property lacking in plasma, was essential for the support of casualties during the period of anesthesia and initial wound surgery.

Because he had been kept so well informed on these matters by Colonel Gillespie, Colonel Kendrick had had extended discussions on the subject of whole blood versus plasma with personnel of the Surgical Consultants Division, Office of the Surgeon General. He considered it essential that Col. Edward D. Churchill, MC, who was ordered to North Africa in January 1943 to serve as consultant in surgery, North African Theater of Operations, U.S. Army, should have the same information before the landings which were to take place in Italy later in 1943. The opportunity to inform him arose during his predeparture briefing in the Office of the Surgeon General, while he was reviewing the filmstrips which had been prepared by Colonel Kendrick on first aid in the field and on resuscitation, including the use of whole blood as well as plasma. Colonel Churchill was also informed that one of the main functions of the Department of Surgical Physiology, Army Medical School, was to investigate and evaluate equipment by which blood could be collected and shipped long distances with expedition and safety. It was suggested to him that, upon his arrival in North Africa, he undertake a study of the whole problem, with the twofold objective of determining (1) whether, with plasma readily available, blood was really needed and (2) if blood was needed, how it could best be provided.

Almost as soon as Colonel Churchill arrived in North Africa and reviewed the situation, he concluded that there was no doubt of the need for large quantities of blood in combat areas to treat casualties with severe wounds. During the next several months, he wrote of this need to The Surgeon General; Brig. Gen. Fred W. Rankin, MC, Chief Consultant in Surgery, Surgical Consultants Division; Colonel Carter; and Maj. (later Lt. Col.) Michael E. DeBakey, MC, Chief, General Surgery Branch, Surgical Consultants Division.

Establishment of transfusion unit.—Shortly after U.S. forces landed in Italy, in September 1943, Col. (later Maj. Gen.) Joseph I. Martin, MC, Surgeon, Fifth U.S. Army, urged the theater Surgeon, then Brig. Gen. Frederick A. Blessé, MC, to form a transfusion unit to support Fifth U.S. Army field and evacuation hospitals. In December 1943, Colonel Churchill delegated Maj. (later Lt. Col.) Eugene R. Sullivan, MC, to survey blood transfusion needs and facilities in the Army area.

Meanwhile, General Martin requested British assistance for the landings planned for January 1944 in the Anzio-Nettuno area by British and United States components of the Fifth U.S. Army. In response to this request, the British supplied a blood transfusion unit, which was located with the field and evacuation hospitals near Anzio. Blood was received by this unit from the British blood transfusion unit at Foggia: a large part of the supply was collected from U.S. Army Air Forces personnel in the Foggia area, but the work of collecting and processing was done by British personnel, with British

equipment. U.S. hospitals in the Anzio-Nettuno area received approximately 4,000 pints of blood from this source.

In January 1944, the blood situation was reviewed in all its aspects by General Martin; Col. Richard T. Arnest, MC, Surgeon, Peninsular Base Section; Col. Virgil H. Cornell, MC, Commanding Officer, 15th Medical General Laboratory; and Major Sullivan, representing General Blessé. The need for whole blood was evident, and, as a result of the meeting, plans were made for the establishment of a blood transfusion unit to be located at the 15th Medical General Laboratory, near Naples, Italy.[28] The first blood was collected by this unit on 23 February 1944, and between that date and 9 May 1944 approximately 4,000 pints were collected, most of which was sent to the Anzio beachhead. Even before operation of the unit had begun, it was obvious that the original estimates for collection of an average of 100 pints of blood daily for the use of field and evacuation hospitals were unrealistically low, and the plan was modified to provide for the collection of 200 pints daily.

Development of Equipment and Containers

From the time of the reactivation of the Division of Surgical Physiology, Army Medical School, in 1940, the personnel of the Division had been keenly aware of the following facts:

1. Wounded men who had lost large quantities of blood in combat were poor surgical risks, even though they had received plasma in large quantities.
2. They must receive whole blood in large quantities before they could become safe risks for anesthesia and surgery.
3. A whole blood program would become practical only when an acceptable type of transfusion equipment and satisfactory containers for transportation had been developed.

Long before the reports of the British and U.S. experience in the North African Theater of Operations had begun to be received in the Office of the Surgeon General, the Division of Surgical Physiology, Army Medical School, had been investigating the development, for use in the field, of efficient transfusion equipment which would meet the following requirements:

1. Whole blood could be collected and stored safely only if donors were bled by the utilization of a closed sterile system.
2. The blood must be collected in a preservative solution in which it could be stored safely for 2 or 3 weeks.
3. The chief cause of transfusion reactions is the presence of pyrogens in the recipient sets, usually as the result of improper cleaning. Therefore, the only practical solution of the problem of administering blood in the field would be the employment of an expendable transfusion set, to be used once and then discarded. Under field conditions, the difficulties of cleaning and

[28] Organizational History, 1944, 6703d Blood Transfusion Unit (Overhead).

preparing collecting and recipient sets would make the use of standard equipment both impractical and unsafe.

The equipment eventually developed at the Army Medical School for the storage of whole blood consisted of a 1-liter vacuum bottle for the preservative solution (Alsever's solution) and an expendable recipient set consisting of Monel-metal filters, rubber tubing, and an intravenous needle. Each package also contained typing serum.

All equipment was packaged under sterile conditions and hermetically sealed in an easily opened aluminum cartridge. The cartridges were packed six to a box for export.

Development of Refrigeration

The program for providing whole blood for oversea use could not become a reality until, in addition to the development of equipment for collecting and administering the blood, means of refrigeration had been developed for its storage and for its preservation during transportation. Work was begun as early as 1942 on a light-weight transportable aluminum refrigerator. The model which was eventually developed held 50 bottles of blood and could be operated either from the usual power outlets or from the 24-volt battery ordinarily used in transport planes.

When the need for whole blood in ETOUSA (European Theater of Operations, U.S. Army) became urgent in August 1944, no refrigerated container for the transportation of whole blood had yet been developed, though other organizations had been working with the Division of Surgical Physiology, Army Medical School, on a fiberboard container for this purpose. Even had this container been ready for use when the emergency arose, it is doubtful that it would have been used; the urgent need at that time was for transporting as much blood as possible and utilizing all shipping space in planes for this objective. Refrigeration was then a secondary consideration.

The first blood which was sent to Europe, in August 1944, was therefore shipped without refrigeration. By November 1944, when the shipment of blood to the Pacific was begun, the Navy had developed an excellent refrigerated shipping case. It was a double-walled cardboard box, insulated with 2 inches of cotton waste and with an inner and outer lining of aluminum foil. It held 16 bottles (of 600 cc. content) in a wire rack, in the center of which was a large tin can which held 19 pounds of wet ice. By this device, which was used in all shipments to the Pacific, blood could be kept at a constant temperature for about 24 hours.

Work on the Army refrigerated container was completed shortly after the Navy container became available, but it was not put into use by the Army until April 1945. In the meantime, other expedients were employed, as necessary, in transporting blood to Europe.

Development of Preservative Solutions

Another essential requirement for the shipping of whole blood overseas was the development of a satisfactory preservative solution. Early in 1943, the Army Medical School began comparative studies of various solutions and soon arrived at the conclusion that Alsever's solution was superior to the other solutions then available. This solution, which contains 2.05 gm. of dextrose, 0.42 gm. of sodium chloride, and 0.8 gm. of sodium citrate per 100 cc. solution, has one great disadvantage, that it must be used in 500-cc. amounts for each 500 cc. of blood. This was a serious consideration, particularly in wounds of the head and chest, in which overloading the circulation with excessive fluids could be dangerous.

Otherwise, Alsever's solution had a number of advantages, which were evident in the more than 2,000 transfusions in which it was employed at Walter Reed General Hospital. Criteria of evaluation were (1) the amount of supernatant hemolysis and (2) evidences of clinical improvement after transfusion. Blood collected in this solution had been shipped, unrefrigerated, from Washington, D.C., to the west coast and back and also to Prestwick, Scotland, and back and had been suitable for use at the end of the journeys. It withstood the shaking, as well as the changes of temperature, incident to transportation and storage over long periods of time under adverse conditions. Blood collected in this solution also appeared to store well from 21 to 30 days at 4° C. (approximately 40° F.). It could also be exposed to average room temperature (20° C., 68° F.) for a period of hours without undergoing changes which would make it no longer safe or useful in the treatment of hemorrhagic shock. Finally, Alsever's solution was more easily administered through standard Army filters than was blood preserved in other solutions, which tended to clog these filters, particularly after the blood had been stored for more than 7 days. The explanation probably was the greater dilution of the blood in Alsever's solution; the dilution minimized the precipitation of fibrinogen which occurs when blood is stored in a cold environment. This factor was of special importance in forward hospitals, in which ease of administration was essential.

On 24 September 1943, at the request of the Army and the Navy, the Subcommittee on Blood Substitutes had recommended the use of Alsever's solution for the preservation of blood to be stored more than 5 days.[29] This solution was therefore employed in August 1944, when it became necessary to fly blood to Europe, because it was the only solution immediately available which had been tested in large numbers of cases and which had been approved by the Subcommittee on Blood Substitutes.

Progress had been made, however, in the development of other suitable preservative solutions, and the Loutit-Mollison, A.C.D. (acid-citrate-dextrose)

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[29] Minutes, meeting of the Subcommittee on Blood Substitutes, Division of Medical Sciences, National Research Council, 24 Sept. 1943.

solution seemed particularly promising. On 30 August 1944, the Subcommittee on Blood Substitutes recommended that Alsever's solution be replaced by the Loutit-Mollison solution.[30] This solution, 25 cc. of which is used for each 100 cc. of blood, consists of 1.33 percent trisodium citrate, 0.47 percent citric acid, and 3 percent dextrose; the pH is in the neighborhood of 5.0.

The recommendation of the Subcommittee was not immediately accepted by the Army, on the ground that the A.C.D. solution had not yet been tested in a sufficient number of cases. Moreover, some concern was felt over the increased precipitation of fibrinogen which occurred when it was used and which tended to plug the filters in the recipient sets. Additional studies, however, indicated that this solution preserves red blood cells somewhat better than Alsever's solution, and, in addition, the Navy, which had used it in all the blood flown to the Pacific, had an unbroken record of success with it. These facts, combined with the undeniable advantage of its smaller bulk, were responsible for the Army's changeover to this solution on 1 April 1945.

Development of Blood-Grouping Sera

Studies were also made on blood-grouping sera in the Division of Surgical Physiology, Army Medical School, in collaboration with the Division of Chemistry. Eventually, a highly satisfactory, extremely avid serum was developed, each lot of which, when it was manufactured commercially, was tested at the Army Medical School before it was used.

An effective technique was also devised at the Army Medical School for the rapid identification of group O donors.[31] This was an urgent and important consideration, since only group O blood was sent overseas.

Training of Personnel

Even though blood was not shipped overseas until the summer of 1944, all personnel attending courses given by the staff of the Blood Research Division, Army Medical School, had, since 1943, been trained in the collection of blood, the preparation of equipment, and the typing and cross-matching of blood.

Related programs at the Army Medical School, such as the programs for liquid plasma and dried plasma, afforded some training for a small number of medical officers and enlisted technicians, who were capable of operating blood donor centers. Similar training was given to the officers assigned to the Red Cross blood donor centers. This training included the theory and practice of blood grouping, details of transfusion therapy, and similar matters. All courses conducted at the school for medical officers also included 10 hours' instruction on shock and fluid-replacement therapy.

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[30] Report, Third Conference on Blood Storage, Division of Medical Sciences, National Research Council, acting for the Committee on Medical Research, Office of Scientific Research and Development, 30 Aug. 1944.

[31] Kendrick, D. B., Jr., Elliott, J., Reichel, J., Jr., and Vaubel, E. K.: Supply of Preserved Blood to European Theater of Operations. A Preliminary Report. Bull. U.S. Army M. Dept. 84: 66–73, January 1945.

All through 1943 and 1944, the Committee on Shock and Transfusions and the Subcommittee on Blood Substitutes, National Research Council, emphasized the need of placing trained personnel in charge of the blood program in all phases and at all stages. After the Mediterranean and European theaters had formed their own blood transfusion units, the Transfusion Branch, Surgical Consultants Division, Office of the Surgeon General, and the Division of Surgical Physiology, Army Medical School, collaborated in drawing up tables of organization and equipment for blood transfusion teams. These tables were submitted for approval to Headquarters, Army Service Forces, late in 1944 and were approved early in 1945.[32]

EVOLUTION OF THE OVERSEA BLOOD PROGRAM

Blood Banks in Oversea Theaters

The completion of the various projects just outlined made it practical in the fall of 1943 to draw up a plan for the establishment of blood banks and the development of transfusion services in oversea theaters. There were now available, as the result of the joint activities of the Division of Surgical Physiology, Army Medical School, and the Subcommittee on Blood Substitutes, National Research Council, the following items: (1) An expendable transfusion set, (2) a satisfactory preservative solution, (3) a refrigerator for the storage of blood for as long as 21 days, and (4) satisfactory grouping sera. The safety and efficiency of all of these items had been thoroughly tested, which made it feasible to propose that this equipment be sent to oversea theaters and that the theaters be authorized to train their own personnel in the collection and distribution of blood to all forward and fixed hospitals. The proposed system, on the most exacting analysis, seemed almost foolproof. In particular, it disposed of the chief cause of anxiety in transfusion, the reuse of equipment, a practice which inevitably increases the incidence of pyrogenic reactions under circumstances of warfare.

On 5 October 1943, Colonel Kendrick addressed a memorandum to Colonel Carter on the subject of transfusions in theaters of operations. The plan proposed in this memorandum, which provided for the use of whole blood in general, evacuation, and field hospitals in theaters of operations, was based on the fundamental concept that the handling and use of whole blood and other replacement fluids is a specialized branch of medicine and that to collect blood, to group it correctly, and to transport and preserve it safely requires the services of specially trained personnel. These functions cannot be delegated to untrained personnel because any slip, however trivial, in the collection, processing, and use of whole blood may result in severe and even fatal reactions, in addition to unnecessary and sometimes excessive losses of a scarce and valuable substance.

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[32] War Department Table of Organization and Equipment No. 8-500, 18 Jan. 1945.

A memorandum for The Surgeon General, incorporating the essentials of this plan, was prepared the following month by General Rankin [33] and was hand carried to The Surgeon General by Colonel Carter and Colonel Kendrick.

The plan was rejected on the following grounds:

1. Plasma was regarded as adequate for the resuscitation of wounded men.

2. It was considered impractical, from a logistic standpoint, to make locally collected blood available farther forward than general hospitals in the communications zone.

3. Shipping space was too scarce to warrant using it to send disposable transfusion equipment overseas.

In the light of these facts, it was The Surgeon General's decision that the provision and use of blood in oversea theaters should be limited to the instructions set forth in Circular Letter No. 108.[34] This letter outlined the techniques to be followed in the transfusion of fresh whole blood in general hospitals in oversea theaters within 4 hours after it had been collected. It also provided for the transfusion of stored blood, to be collected by a closed system and to be used within 7 hours after its collection.

The plan which had been proposed to The Surgeon General and had been rejected was presented to the Subcommittee on Blood Substitutes by Colonel Kendrick at the meeting on 17 November 1943.[35] After the matter had been thoroughly discussed from the standpoint of its practical implications, the following motion was moved and passed:

> RESOLVED: That the Subcommittee on Blood Substitutes recommend through channels that the Surgeon General of the Army give consideration to the transportation of whole blood by airplane to certain theaters of operations.[36]

Although a satisfactory airlift was available when this plan was presented to The Surgeon General, the proposal was rejected, principally, again, on the grounds that (1) plasma was adequate for resuscitation of battle casualties and (2) flying blood overseas was not practical.

Although personnel in charge of the blood program were not in agreement with The Surgeon General's decision, they had no choice but to accept it. The basic reason for The Surgeon General's refusal to consider the proposed program was undoubtedly that he shared the still rather general opinion

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[33] Memorandum, Brig. Gen. F. W. Rankin for The Surgeon General, 6 Nov. 1943, subject: Transfusion of Whole Blood in the Theaters of Operations.

[34] Circular Letter No. 108, Office of the Surgeon General, U.S. Army, 27 May 1943, subject: Transfusion of Whole Blood in the Theaters of Operations.

[35] At the meeting of the Subcommittee on Blood Substitutes on 24 September 1943, everyone who had been present at the meeting of the Committee on Shock and Transfusion held on 3 November 1941 agreed that it had been the consensus of the group that the Armed Forces should use whole blood in the treatment of shock whenever possible. The discussion had been omitted, unfortunately, from the minutes of the meeting, and it was suggested that the minutes be corrected to conform with the facts.

[36] Minutes, meeting of the Subcommittee on Blood Substitutes, Division of Medical Sciences, National Research Council, acting for the Committee on Medical Research, Office of Scientific Research and Development, 17 Nov. 1943.

that plasma was a satisfactory agent of resuscitation and that the use of whole blood in large amounts in battle casualties was not necessary. Undoubtedly also, he had been directed by higher authority to limit the amount of medical supplies shipped overseas. It therefore seems reasonable to assume that, since he shared the general belief that plasma was adequate for resuscitation, he did not consider that supplying transfusion equipment in order to liberalize the use of whole blood was sufficiently important either to substitute the equipment for other supplies and thus keep within the allowable tonnage, or to point out to the Commanding General, Army Service Forces, under whom his office operated, the urgency of making an exception in order to supply whole blood for wounded men.

Provision of Blood From Zone of Interior for European Theater

Early in 1943, Brig. Gen. [illegible]er Maj. Gen.) Paul R. Hawley, MC, Chief Surgeon, ETOUSA, had directed that provision be made for supplying whole blood to combat casualties. Plans for obtaining the blood and flying it from the United Kingdom Base after D-day had been completed by 31 May 1944.[37] The operation was conducted with great efficiency by Maj. (later Lt. Col.) Robert C. Hardin, MC, Senior Consultant in Shock and Transfusion, and Lt. Col. (later Col.) James B. Mason, MC, Chief, Operations Division, Office of the Chief Surgeon, ETOUSA.[38]

As early as April 1944, those responsible for the provision of blood for the European theater had given urgent thought to the acquisition of type O whole blood from the Zone of Interior. Even before D-day, it had become evident that a sufficient supply of blood for the estimated combat casualties could not otherwise be provided, and urgent requests had been made for blood to be sent from the Zone of Interior to the European theater. After D-day, these requests increased in urgency as it became more and more evident that using troops in the United Kingdom Base as donors was completely impractical to supply the amount of blood needed for the adequate treatment of thousands of casualties with multiple wounds.

Blood from the United Kingdom Base was in reasonably adequate supply from D-day until just before the operations in the Saint-Lô area which culminated in the breakthrough on 18–19 July 1944. Then it became a critical item of supply. It actually had to be rationed and allotted to the areas in which the greatest number of casualties were anticipated. The daily demand for blood had risen steadily and by the first of August was between 1,000 and 1,500 pints.

On 3 August 1944, a radio request was received by The Surgeon General from General Hawley asking for one thousand 500-cc. units of whole blood per day for the European theater. On 13 August 1944, with General Hawley's

[37] Mason, J. B : Planning for the ETO Blood Bank. Mil. Surgeon 102 : 460–468. June 1948.

[38] Mason, J B : The Role of the ADSEC in the Supply of Whole Blood to the Twelfth Army Group. Mil. Surgeon 103 : 9–14. July 1948.

approval, Col. (later Brig. Gen.) Elliott C. Cutler, MC, Chief Consultant in Surgery, Office of the Chief Surgeon, ETOUSA, flew to the United States, accompanied by Major Hardin, to request The Surgeon General to supply generous quantities of whole blood to the troops in Europe by an airlift from the Zone of Interior. In their presentation, these officers made it perfectly clear that, unless blood could be made available in quantities far beyond the amounts which could possibly be provided overseas, wounded men with multiple wounds would receive less than optimum treatment and some of them would certainly die.

The plan for an airlift of blood to Europe which had originally been proposed in November 1943 and which had not then been found acceptable was modified in certain details, to meet the exigencies of the present situation,[39] and was again presented to The Surgeon General. It was approved at once.

Colonel Cutler and Major Hardin made their request for an airlift of blood to Europe on 17 August 1944. Four days later, on 21 August, the first shipment was flown from the Zone of Interior to Prestwick, Scotland. It was transshipped to Salisbury, England, the base of the ETOUSA Blood Bank, and thence was flown to France. On 28 August, Colonel Kendrick left the Zone of Interior with a large shipment of blood. His request for orders for oversea travel had been justified by the reasoning that it was simply not possible to put a system, however good it might be, on paper and expect it to work of itself. When blood was the substance to be transported, it was considered essential to follow it up, to see that it was properly handled at every point along the way, and also to see that it was properly used.

Critique of Results

From 6 June to 20 August 1944, all the blood used in all ETOUSA hospitals on the Continent was collected in England and flown across the Channel (fig. 26). Of the 385,231 pints of whole blood handled by the ETOUSA Blood Bank between 22 May 1944 and 24 May 1945, 197,712 pints (51.3 percent) were flown from the United States.[40]

The ability to provide blood in such quantities so promptly when the need in the European theater became imperative was the end result of the previous activities of many persons and organizations, as follows:

1. By this time (August 1944), the American Red Cross had 35 bleeding centers in operation throughout the country. The Red Cross program was well controlled by the appropriate committees of the National Research Coun-

[39] Memorandum, Brig. Gen. F. W. Rankin for The Surgeon General, 3 Aug. 1944, subject: Provisions for Supplying Whole Blood to ETO From U.S.A.

[40] See footnote 38, p. 149.

cil, and cooperation between the Council and Army and Navy personnel working on the blood program was invariably excellent.

2. All the equipment needed was ready, and ready in sufficient quantities. The Army and Navy personnel working on the blood program had for many years worked closely with the manufacturers of transfusion equipment, and, when the urgency of the situation was made known to these firms, they provided promptly all the help and cooperation required.

3. A satisfactory preservative was available (p. 145). Alsever's solution had the disadvantage of bulk, and it is regrettable that the Loutit-Mollison (A.C.D.) solution, which had the advantage of less bulk and which was found later to be just as efficient, was not sanctioned earlier by the Subcommittee on Blood Substitutes, Division of Medical Sciences, National Research Council, and was not accepted earlier by the Army when it was later recommended by the Subcommittee. Alsever's solution, however, filled the initial needs of the situation admirably.

4. Although a satisfactory refrigerated shipping case was not available when blood was first flown overseas to Europe, Alsever's solution permitted a 15-day storage period, and there was no spoilage because of this lack. The shipment of 500 bottles which Colonel Kendrick took over on his flight was checked at intervals, and the temperature in the pasteboard containers did not vary more than 6° F. (3.3° C.) in the approximately 12 hours which it took to cross the ocean from New York to Prestwick, Scotland. The aircraft flew at an altitude of from 8,000 to 10,000 feet, and it was cool all the way. Fortunately, fall was near when the demand for blood became urgent, and, before the need ceased, in May 1945, a refrigerated case was in use and the change had been made from Alsever's to the Loutit-Mollison solution.

5. Although the training of personnel in the Zone of Interior had never been formalized, informal training had been provided, as far as this was possible, by those in charge of the blood program. It had always been recognized that blood would eventually be flown overseas and that it must be handled all along the way by specially trained personnel and not in routine medical supply channels.

In addition to the personnel trained for direction of the centers in which blood was collected for liquid plasma (p. 134), the officers in the courses at the Army Medical School since 1943 had been instructed in resuscitation in all of its aspects and had also been taught to realize the importance of special handling of blood even though they did not, themselves, know the precise details. Trained personnel were already available in the European theater, and in the Mediterranean theater, although the latter theater never received blood from the Zone of Interior.

6. Finally, an efficient airlift was available. From the geographic standpoint, the Red Cross bleeding center in New York was most suitable for the

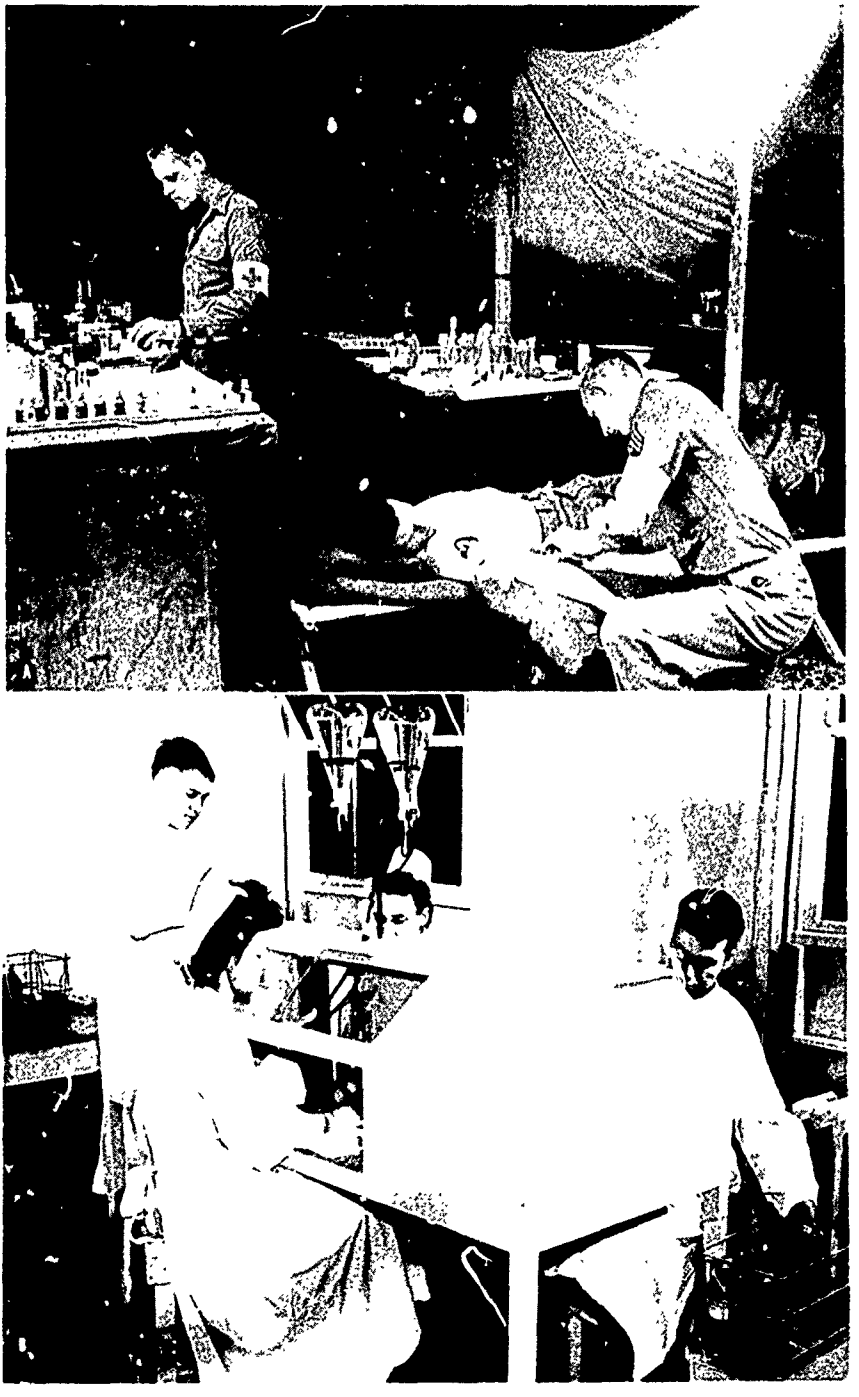


FIGURE 26.—(See opposite page for legends.)



FIGURE 26.—Processing of blood in European theater before airlift from Zone of Interior was instituted. A, Donor being bled by a collecting team. B, Addition of glucose as preservative to blood. C, Loading refrigerated truck with bottles of blood for shipment.

collection of blood for the European theater, since New York was the port of embarkation for this theater. All of the blood collected here, however, could not be sent overseas, because part of it had to be designated for an adjacent plasma processing center. The first shipments of blood sent to Europe were collected in New York, but, by the time the overseas program was fully operative and from 1,000 to 1,500 pints per day were being delivered to the European theater, blood designated for the theater was being collected from areas as far away as Washington, D.C., and Syracuse, N.Y. (fig. 27).

With very occasional exceptions, whether the blood was flown from the United States or was procured locally, only type O blood was used for transfusion in all theaters of operations. In the Mediterranean theater, high-titer O blood was reserved for type O recipients, and only low titer blood (not exceeding 1:64) was used universally.

Blood was not routinely supplied to either collecting or clearing stations, on the logical ground that surgery was not permitted in them and that blood was most useful in installations in which surgery was performed. Blood was

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FIGURE 27.—Blood, donated in Brooklyn 10 days previously, being stored in the 48th Field Hospital, ETO.

used in surprisingly large quantities in both field and evacuation hospitals. A patient who had sustained multiple injuries associated with massive hemorrhage frequently had a hematocrit of 25 or 30, and frequently required 4 to 6 pints of blood before it was restored to a level at which initial wound surgery was practical.

Furthermore, the fact that a low hematocrit had been raised to approximately normal by the transfusion of blood in a field or evacuation hospital, immediately after trauma, by no means indicated that the hematocrit would be maintained at this level. Wounded men with multiple wounds, even if they had withstood surgery in a field hospital after the transfusion of 6 or 8 pints of blood before or during operation, or both, often had to receive additional quantities before definitive surgery in a general hospital overseas. The liberal use of blood was often necessary in Zone of Interior hospitals also.

Although general hospitals in oversea theaters could have operated their individual blood banks if they had had the necessary equipment, it does not follow that this would have been a desirable practice. One of the advantages of a special transfusion service is that control of the blood is never decentralized. The responsibility for maintenance of sterility and the provision of properly grouped blood is inherent in the laboratories on the special transfusion service. These precautions are as necessary in general hospitals as in field and evacuation hospitals.

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OVERSEA TRANSFUSION SERVICES

The European Theater of Operations

After he had arrived in the European theater late in August 1944, Colonel Kendrick spent the next 2 months in England and on the Continent including Italy.[41]

Information on developments in the use of whole blood had been sent to the Office of the Chief Surgeon, ETOUSA, by means of copies of the monthly Essential Technical Medical Data reports from other theaters and through other sources. In addition, Colonel Sullivan and Major McGraw, from the Mediterranean theater, had visited the European theater before D-day and had reported on the operation of the blood bank in the Mediterranean theater, which had been an active theater of operations for 2½ years before D-day in Europe.

It is important to realize that the military situation in the two theaters was entirely different and that the medical situation differed accordingly. In the Mediterranean theater, a single army was operating on a single land mass, within a relatively limited area. Although serious transportation problems existed in the Mediterranean theater, blood did not have to be flown across water. Blood was necessarily flown from England to the Continent, which meant that, in bad weather, blood could be transported to the European theater. This was an extremely serious matter in the European theater, for the always limited supply of blood did not permit storage in any significant amounts.

There were also other differences. In Italy, medical control could be uniform; there was one army and one army surgeon. In the European theater, several armies were operating, and each army surgeon, like each army commander, had his own concepts of how to care for patients. The use of blood was only one of many therapeutic methods in which medical personnel, inexperienced in the treatment of combat casualties, required careful indoctrination and instruction. The First and Third U.S. Armies had been in combat only a relatively short time when blood began to be supplied to them in liberal quantities. The Third U.S. Army, in fact, had been operational for less than 3 weeks. In either Army, there had been no chance to set up research teams and little time for operating surgeons to grasp the urgent need for the use of whole blood in liberal amounts.

The transfusion service in operation when Colonel Kendrick arrived in the European theater showed how excellent such a service could be, even without support from the Zone of Interior, when it was under the control of a competent medical officer who used all the resources available to

[41] Report, Lt. Col. Douglas B. Kendrick, Professional Service Division, Office of the Chief Surgeon, to Chief Surgeon, ETOUSA, 26 Sept. 1944, subject: Report of Trip to First and Third Army Medical Installations.



FIGURE 28. Administration of blood in a forward area in France.

from (fig. 28). The lesson that had to be taught in the European theater was not the value of whole blood for severely wounded men but the desirability of using it in liberal quantities and the availability of the supply. Colonel Kendrick's task in this theater was to convince operating surgeons who had been used to a mere trickle of blood, which had to be reserved for the casualties whose condition was poorest, that they could now be assured of all the blood they needed and that they could use it prophylactically as well as for casualties whose condition was dire. He had some difficulty in persuading these surgeons that all they needed to secure blood in any desired quantity was to ask for it in that quantity.

One of the interesting developments in the European theater, as in the Mediterranean theater, was the increasing use of blood as experience increased. Eventually, in both theaters, the ratio of units of blood to wounded was close to 1:1.

The Mediterranean Theater of Operations

In the Mediterranean theater, where the Fifth U.S. Army had been in combat for almost 2 years, the need for whole blood in the treatment of severely wounded battle casualties had been promptly recognized (p. 112). After repeated requests from the theater, transfusion equipment and refrigerating apparatus had finally been shipped from the Zone of Interior, and a transfusion service had been established early in 1944.

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A highly efficient blood bank had been developed.[42] Blood was obtained from volunteer donors who, it was certain, would not go into combat within a specified period of time. By the expedient of paying each donor $10 per pint, all the blood needed could be secured. A C-47 plane, which had been made available to the 15th Medical General Laboratory, flew the blood to designated centers, whence it was delivered to forward areas by truck and ambulance. Delivery was often an achievement of considerable magnitude, in view of the frequently unfavorable flying weather and the bad roads constantly crowded with military transport. The blood, however, always got through.

This theater, in 1943, had set up a board for the study of the physiologic effects of wounds,[43] and the interest of the board members and others in the whole question of shock and resuscitation, including posttransfusion anuria, had created a great interest in replacement fluids in all field and evacuation hospitals and had served as a real stimulus to the effective use of whole blood.

In the Mediterranean theater, therefore, Colonel Kendrick's function was chiefly to listen and learn. He frequently regretted that circumstances had not permitted him to visit this theater before he visited the European theater. He brought back many valuable ideas to the Zone of Interior not only about the use of whole blood but also about the cardinal principles of resuscitation, including such details as the maintenance of an adequate airway and aspiration of pneumothoraxes to restore normal respiratory physiology and improve respiratory exchange by injections of procaine hydrochloride to control pain in patients with fractured ribs.

PROVISION OF BLOOD FROM ZONE OF INTERIOR TO PACIFIC AREAS

Because of the close liaison maintained between Commander Newhouser of the U.S. Navy and Colonel Kendrick, it was logical that when the former was sent to the Far East in June 1944 to survey the situation in respect to the distribution and correct use of albumin, Colonel Kendrick should have been given orders to accompany him, to study the distribution and use of plasma, as well as the provisions for whole blood.

The Situation in June 1944

Supplies of plasma in the Pacific had been adequate for a long time. Albumin, which was just beginning to arrive in June 1944, was never widely used in Army medical installations.

In SWPA (Southwest Pacific Area), blood had been provided up to this time from three sources as follows:

1. It was collected locally in each installation, as the need for it arose.

[42] See footnote 28, p. 143

[43] Medical Department, United States Army. Surgery in World War II. The Physiologic Effects of Wounds. Washington: U.S. Government Printing Office. 1952.

of the Chief Surgeon, USASOS, SWPA; and a number of others who had a special interest in the use of whole blood. By a presentation of all the details of the program, Colonel Kendrick was able to show these officers that they could have all the blood they needed, sterile, safely refrigerated, and delivered according to their requests, if they merely made the requests.

In the month Colonel Kendrick spent with the Sixth U.S. Army, which was staging for the Luzon operation, he worked out a whole-blood program for this invasion and arranged for the delivery of blood from Guam according to estimated needs from D-day onward. From the standpoint of the use of whole blood, the Leyte operation could have been more efficiently handled. The operation on Luzon was well handled from this standpoint, one of the chief reasons being that Colonel Kendrick had been able to locate, on Leyte, a trained pathologist and fine medical officer, Capt. Henning H. Thorpe, MC, who, with totally inadequate sources, had done his best to supply the Sixth U.S. Army needs for whole blood. When Captain Thorpe came into the program, most of the operational difficulties had been cleared away.

The Luzon campaign was the first in the Pacific in which whole blood was given to nearly all casualties with moderate and severe wounds, regardless of whether or not they were in shock when they were received in field and evacuation hospitals. After this operation, it took little effort to convince Sixth U.S. Army medical officers, both at headquarters and in the field, of the value of the blood program.

The Okinawa Operation

When Colonel Kendrick returned to Hawaii after his tour in the Southwest Pacific, which had included several days of conferences with Lieutenant Brown on Guam, he was relieved of his responsibilities for the blood program in the Pacific and was never replaced. He was assigned to command a Tenth U.S. Army field hospital, which was designated to land on Okinawa on D+60. Before Colonel Kendrick could report to this hospital, Col. Frederic B. Westervelt, MC, Surgeon, Tenth U.S. Army, assigned him to his headquarters as consultant on blood and shock for the Okinawa operation, for which this army was then staging. In this capacity, Colonel Kendrick was able to see that the ships which went to Okinawa from Saipan were loaded with all the blood likely to be needed for the first days of the operation.

On the first days after the landings, Colonel Kendrick, accompanied by Col. George G. Finney, MC, Consultant in Surgery, Office of the Surgeon, Tenth U.S. Army, Lt. Col. (later Col.) Harold A. Sofield, MC, and Col. Walter B. Martin, MC, made daily trips ashore for indoctrination purposes. During this period, and for the first few days after the Tenth U.S. Army went ashore, the circumstances were peculiarly propitious for this purpose. The Japanese had retreated south as the landings had been made, and it was a week before real resistance was encountered. During this interval, it was

At no stage along the way was the blood ever touched by any but trained, specialized personnel, whose assignments were permanent. In the Pacific, in fact, blood was consistently handled by what amounted to a special delivery service, which is the only safe and proper way to handle it. It is important to emphasize, however, that the highly efficient blood service in the Pacific had its roots in the experience gained in the Zone of Interior, the Mediterranean theater, and the European theater after 4 years of warfare.

The first blood for the Pacific areas left the Zone of Interior on 25 November 1944 and was sent to Leyte via Guam. Colonel Kendrick reached Hawaii on 25 November and went to Leyte, also via Guam, to discuss the whole problem of the use and supply of blood with Lieutenant Brown and with medical officers in the office of Maj. Gen. Guy B. Denit, MC, Chief Surgeon, USASOS (U.S. Army Services of Supply), SWPA.

The Leyte and Luzon Operations

The first blood shipped from Guam to Leyte provided a perfect illustration of what can happen to this precious commodity when once it leaves the care of personnel specially trained to handle it. When this blood, which had been so carefully protected all the way from the Zone of Interior, reached Leyte, it left the hands of trained personnel. It was at once taken out of the refrigerated containers in which it had been received, thrown into trucks, and transported, over a 4- or 5-hour period, to the medical installations which had requested it. At this season, Leyte was a place in which it was possible to have mud on the shoes and dust in the eyes at the same time. The temperature was 100° F. in the shade, and the humidity was extreme. The casual treatment of the blood under these circumstances rendered it entirely unusable, and the carefully worked out program was in a fair way to being wrecked.

In November 1944, there were no personnel in the Pacific theaters with the responsibility of receiving and supervising the handling and distribution of blood, or with the authority to undertake these tasks. More important, there was no general recognition of the importance of the liberal use of blood in battle casualties. Colonel Kendrick's task of indoctrination was not particularly easy. He had to convince the medical officers of an army which had been fighting effectively for several years that the blood program had a great deal to offer them. He also had to convince the medical officers of an army which had never had enough of anything that they could have all the blood they needed and wanted merely by asking for it. It was fortunate that he had visited the Mediterranean and European theaters before he went to the Pacific, for he was able to bear eyewitness testimony to the feasibility and usefulness of the plan he was advocating.

Through the wholehearted and efficient cooperation of Maj. (later Lt. Col.) Frank Glenn, MC, Consultant in Surgery, Office of the Surgeon, Sixth U.S. Army, a meeting was arranged with the senior medical officer of the Navy in the area; representatives of the Surgeon, Sixth U.S. Army; representatives

of the Chief Surgeon, USASOS, SWPA; and a number of others who had a special interest in the use of whole blood. By a presentation of all the details of the program, Colonel Kendrick was able to show these officers that they could have all the blood they needed, sterile, safely refrigerated, and delivered according to their requests, if they merely made the requests.

In the month Colonel Kendrick spent with the Sixth U.S. Army, which was staging for the Luzon operation, he worked out a whole-blood program for this invasion and arranged for the delivery of blood from Guam according to estimated needs from D-day onward. From the standpoint of the use of whole blood, the Leyte operation could have been more efficiently handled. The operation on Luzon was well handled from this standpoint, one of the chief reasons being that Colonel Kendrick had been able to locate, on Leyte, a trained pathologist and fine medical officer, Capt. Henning H. Thorpe, MC, who, with totally inadequate sources, had done his best to supply the Sixth U.S. Army needs for whole blood. When Captain Thorpe came into the program, most of the operational difficulties had been cleared away.

The Luzon campaign was the first in the Pacific in which whole blood was given to nearly all casualties with moderate and severe wounds, regardless of whether or not they were in shock when they were received in field and evacuation hospitals. After this operation, it took little effort to convince Sixth U.S. Army medical officers, both at headquarters and in the field, of the value of the blood program.

The Okinawa Operation

When Colonel Kendrick returned to Hawaii after his tour in the Southwest Pacific, which had included several days of conferences with Lieutenant Brown on Guam, he was relieved of his responsibilities for the blood program in the Pacific and was never replaced. He was assigned to command a Tenth U.S. Army field hospital, which was designated to land on Okinawa on D+60. Before Colonel Kendrick could report to this hospital, Col. Frederic B. Westervelt, MC, Surgeon, Tenth U.S. Army, assigned him to his headquarters as consultant on blood and shock for the Okinawa operation, for which this army was then staging. In this capacity, Colonel Kendrick was able to see that the ships which went to Okinawa from Saipan were loaded with all the blood likely to be needed for the first days of the operation.

On the first days after the landings, Colonel Kendrick, accompanied by Col. George G. Finney, MC, Consultant in Surgery, Office of the Surgeon, Tenth U.S. Army, Lt. Col. (later Col.) Harold A. Sofield, MC, and Col. Walter B. Martin, MC, made daily trips ashore for indoctrination purposes. During this period, and for the first few days after the Tenth U.S. Army went ashore, the circumstances were peculiarly propitious for this purpose. The Japanese had retreated south as the landings had been made, and it was a week before real resistance was encountered. During this interval, it was

therefore possible for these officers to visit every field and evacuation hospital ashore, whether Army or Navy, and to pass on to the hospital staffs all the information in their possession, including the information Colonel Kendrick had secured in the Mediterranean and European theaters, about the correct use of whole blood for battle casualties. When the hard fighting started, the medical officers responsible for the care of battle casualties were well trained, and the ratio of blood units used to casualties was 1 : 1 (40,000 casualties, 40,000 pints of blood used). At this time, in Europe, the ratio was 0.9 : 1.

After the development of the blood program and indoctrination in resuscitation on Okinawa, Colonel Kendrick assumed command of the 31st Field Hospital, where observation of the approximately 10,000 casualties who passed through it gave him an excellent opportunity to study in detail the use of blood at this level.

Critique of Results

The experience in the Pacific demonstrated the following facts:

1. It is perfectly practical to collect blood in the Zone of Interior and deliver it to a theater far removed from the mainland. It was not unusual for blood to be collected in the United States, sometimes in cities as far inland as Chicago, and to be used in places as remote from the point of collection as Okinawa within 6 days after it had been collected.

2. A theater transfusion officer with his staff, attached to the office of the theater surgeon and given the proper authority and resources, can keep a combat force adequately supplied with blood.

3. The resources made available to this officer must, however, include all the staff, personnel, and equipment necessary to collect, process, and deliver whole blood to any medical installation in the theater.

4. In dealing with a commodity such as blood, which has only a brief life and which is easily contaminated and rendered not only useless but harmful, handling and distribution must be the responsibility of medical officers and other personnel trained in this particular specialty. Blood cannot be handled either efficiently or safely through conventional supply channels.

PLANNING FOR THE INVASION OF JAPAN

Just before the end of the campaign on Okinawa, at the suggestion of Col. I. Ridgeway Trimble, MC, Consultant in Surgery, Office of the Chief Surgeon, SWPA, General Denit invited Colonel Kendrick to Manila to develop the planning for the blood program for the invasion of Japan (Operation OLYMPIC). There was sufficient time to send the plans to the Office of the Surgeon General, so that Major McGraw, then serving as representative on blood and transfusion, could comment on them in the light of his experiences in the Mediterranean theater. It was interesting that

even at this late date, while Sixth U.S. Army medical personnel attached to the Chief Surgeon's office fully recognized the urgent need for whole blood, they were still doubtful that all that was regarded as necessary for the invasion of Japan could be supplied.

After the program to supply blood from the mainland had once been instituted, there was never a shortage of blood in the Pacific Ocean areas. At times, when the weather was bad and supplies for only 24 hours were on hand, some concern was felt, but, as in the European theater, the blood never failed to arrive when and where it was needed. Had Operation OLYMPIC come to pass and had the estimated five or six hundred thousand casualties occurred, there seems little doubt that sufficient supplies of blood could again have been provided for all their needs.

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Surgical Consultants in the Service Commands

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CHAPTER VII

First Service Command

Condict W. Cutler, Jr., M.D.

Consultation service in surgery began in the First Service Command upon appointment of Lt. Col. (later Col.) Condict W. Cutler, Jr., MC, as consultant in general surgery in December 1943. Colonel Cutler reached his station, Boston, Mass., on 12 December. A few days earlier Maj. (later Lt. Col.) Wilfred Bloomberg, MC, had been assigned as neuropsychiatry consultant, and shortly afterward Lt. Col. (later Col.) George P. Denny, MC, arrived to become the service command medical consultant. It was immediately necessary to establish a plan of procedure with the service command surgeon and the headquarters staff as to the consultants' duties and the methods of carrying them out. It was decided first to begin an evaluation of professional personnel.

This function of professional evaluation continued throughout to be a major activity of the surgical consultant. Repeated visits, questioning, and observation served to correct impressions of the qualifications of professional personnel. The classification of medical officers became a formal process on a national standard in June 1944.[1] It remained the function of the consultant to verify the correctness of the military occupational specialty numbers assigned to individual officers.

In initiating visits to installations, the service command surgeon proposed that visits by the consultants be made in a group. The consultants felt that separate visits would not impose inconvenience on the staffs of the hospitals, since their activities would involve different services. It was recognized also that the needs of hospitals for visits by the consultants would differ considerably and that the arrangement of team visits would result in unnecessary visits by certain consultants. They were agreed that visits by consultants should be arranged individually and that each, with the approval of the service command surgeon, should work out his own schedule according to his best judgment.

Subsequent events proved the correctness of this attitude. When visits were undertaken as a team, virtually all work at a hospital was temporarily interrupted. The length of time required by the three consultants for the completion of their work differed considerably. After several team visits had been made, the plan of combined visits was abandoned.

The surgical consultant prepared an outline on the purpose of consultant visits which included the following points:

1. Observing (1) the care and handling of patients, (2) the adequacy, maintenance, and condition of medical facilities and equipment, (3) the pro-

[1] War Department Circular No. 232. 10 June 1944.

fessional abilities of medical officers, (4) the extent of employment of medical officers to the best advantage, (5) the maintenance of standards, ethics, therapy, and educational activities, (6) the status of cooperation, leadership, and morale, (7) the degree of efficiency in records maintenance, and (8) the degree of efficiency in the movement of patients to final disposition.

2. Making recommendations at the installation for the improvement of any condition which might require only local action.

3. Determining personal problems, aspirations, and attitudes of medical officers.

4. Consulting with the professional staff on technical problems.

5. Promoting educational activities by (1) bedside discussion of cases, (2) arranging staff meetings, conferences, et cetera, (3) arranging graduate medical meetings and programs, (4) encouraging medical officers to pursue candidacy for specialty board certification and professional societies, (5) giving talks, lectures, or demonstrations, and (6) encouraging clinical research.

6. Rendering reports on the above matters.

There was a tendency at first on the part of hospital commanders to refer to consultant visits as inspections and to expect investigation, criticism, and a formal report. Every method was employed to have it understood that the purpose of the consultant's visit was purely professional and that it was intended to be constructive and profitable. Very shortly, the feeling of apprehension was overcome and the visits were thereafter welcomed.

In addition to the regular visits, hospital officials were given to understand that the surgical consultant would at all times be at the call of hospitals for aid in clinical problems. It was agreed that the chiefs of service in hospitals should have free access by phone or letter to the surgical consultant for personal discussion of professional problems. This arrangement contributed greatly to the effectiveness of the consultant's services.

It was believed desirable to effect a close cooperation with the personnel officer in the office of the service command surgeon. It was necessary that the consultants be consistently informed of changes and transfers of personnel and that serious consideration be given to their recommendations. An effective working agreement was established with the personnel officer. The necessity for this arrangement was shown by the need for numerous adjustments of the staffs of various hospitals to accommodate for shortages created by transfer of officers for oversea assignments. It was necessary also that the personnel officer be aware of the identity of key medical officers and that he request replacements should they be reassigned. He was guided largely by the consultant as to the professional acceptability of replacements and as to their placement.

There was at first a tendency on the part of hospital commanders to assume that the assignment of professional personnel to positions of relative importance on the surgical staffs should correspond with their relative ranks. This policy would not have led to maximum efficiency since there were instances in which the degree of professional competency was not consistent with mili-

tary rank. Eventually, the principle was established that assignments as chiefs of service or chiefs of section would be governed by professional capacity. This permitted the placement of the most able men in positions of professional control with men of less competence, even though of higher rank, under their supervision.

As the exigencies of the military situation required the withdrawal of surgeons for oversea service, it was the practice of the Office of the Surgeon General to offer replacements. The policy of permitting the Zone of Interior establishments to absorb the timelag involved frequently produced troublesome shortages of personnel. This lag was not infrequently as long as from 60 to 90 days and required local adjustments of personnel. When general shortages existed, as was the case with orthopedists and eye, nose, and throat specialists, such adjustments were not readily effected.

To aid in the work of Lovell General Hospital, Fort Devens, Mass., when medical officer shortages existed, it was customary to utilize officers of the Medical Department Replacement Pool at Lovell. This aid would have been of great assistance at other hospitals could these officers have been assignable on temporary duty to them. Authority thus to utilize their services was lacking. Recently commissioned officers assigned on an intern basis, however, proved very helpful as ward officers.

Another personnel difficulty arose from the transfer of trained enlisted technicians for oversea assignments. The necessity for constantly retraining replacements to take the places of well-trained orderlies, operating-room assistants, and other technicians imposed a serious handicap on surgical activities at hospitals.

The surgical consultant visited all hospitals as frequently as possible. In 1944, the consultant made 42 regular visits to 18 hospitals and numerous special visits in response to calls. Numerous special visits were also made in company with The Surgeon General, specialist military consultants, and civilian consultants.

On regular visits, special inquiries were made, as directed by Brig. Gen. Fred W. Rankin, Director, Surgical Consultants Division, Office of the Surgeon General, on the treatment of hernia, pilonidal disease, skin-grafting, and varicose veins, and also on the furnishing of eyeglasses, surplus instruments, anesthesia and anesthetics, the use of tourniquets, and other matters.

On 12 June 1944, as a check on the surgical services, Colonel Cutler sent a letter to all chiefs of services through their hospital commanders. This letter began: "In expectation of increasing activity in the Hospitals of this Command, it is desirable that the following matters concerning each Surgical Service should be examined at the present time and corrective measures taken wherever appropriate." The letter detailed requirements and standards with respect to: (1) Personnel, including officers, nurses, physiotherapists, corpsmen, and technicians; (2) equipment and supplies, such as instruments, sterilizers, and central supply; (3) operating room, including physical equipment,

management, aseptic and operative technique, anesthesia, and postoperative care of patients; (4) ward services, comprising arrangement, supplies, instruments and dressings, and dressing and treatment technique; and (5) laboratory service. The letter also concerned X-ray, physiotherapy, reconditioning, and staff activities, including ward rounds, conferences, reviews of current literature, investigation and preparation of original material, and the progress of individual staff members toward licensure by the American College of Surgeons and the various boards.

During July 1944, the consultant surveyed activities in anesthesia throughout the command and reported the results to General Rankin.

Other activities of the surgical consultant consisted of giving talks and demonstrations, participating in clinics and conferences, assisting in the program of the Committee for War-Time Graduate Medical Meetings, and acting as consultant in reconditioning activities. Reports on his activities were regularly rendered to the service command surgeon, to General Rankin, and, more formally as indicated, to The Surgeon General. These reports provided the material from which much of the narrative to follow was obtained.

MEDICAL INSTALLATIONS AND FACILITIES

During the latter part of December 1943 and the first part of January 1944, Colonel Cutler made a complete round of visits to hospitals of the command. At this time, the medical treatment facilities of the First Service Command were dispensaries; station hospitals of the harbor defenses, ports of embarkation, training camps and centers, and airfields; and general hospitals.

Dispensaries were located at service command headquarters and Fort Banks for the Boston area, at Watertown Arsenal, Mass., at Springfield Armory, Mass., at various institutions of learning where there were training cadres and military students, and in certain separate battalions. At each of the dispensaries, there were officers capable of administering minor surgical treatments and of determining cases requiring hospitalization. Until the close of war, changing conditions affected these facilities very little. They continued to serve the outpatient needs of their areas.

The station hospitals of the various harbor defense posts of the Eastern Defense Command were important factors at the beginning of 1944. The harbor defenses were maintained at nearly full authorized strength and required full manning of their station hospitals. In addition to their normal duties, these hospitals made examinations for induction, cared for certain dependents, and treated casuals taken ill or injured in the neighboring areas. Most of these station hospitals were housed in permanent brick buildings on the old posts, and many of them maintained subsidiary hospitals, as well as dispensaries, at outlying posts.

Typical of these hospitals was the station hospital at Fort Banks. This hospital received patients from the Harbor Defenses of Boston and also served as the admitting hospital for all military personnel in the area of metropolitan Boston. In 1943, it treated 5,570 patients. In January of 1944, its rated capacity was 205 beds. There was considerable crowding, and it was necessary to use auxiliary wards. The staff of Fort Banks Station Hospital controlled medical treatment facilities at Fort Strong, where the facility was then being operated on dispensary basis; Fort Warren, which had a 25-bed station hospital; and Fort Ruckman, Fort Dawes, Fort Revere, Fort Heath, Fort Duvall, and Fort Standish, all six of which had facilities operated on a dispensary basis. Fort Andrews had a 75-bed permanent hospital building. The forts were subposts of Fort Banks.

The other harbor defense station hospitals were the station hospital at Fort H. G. Wright, located on Fisher's Island, N.Y., and serving the Harbor Defenses of Long Island Sound; the one at Fort Adams, Newport, R.I., serving the Harbor Defenses of Narragansett Bay; the one at Fort Rodman, serving the Harbor Defenses of New Bedford, Mass.; the station hospital at Camp Langdon near Portsmouth, N.H.; and that at Fort Williams, serving the Harbor Defenses of Portland, Maine.

At the time of the earlier visits, these installations were quite active and, because of the number of troops in the harbor defenses, it was necessary to maintain an adequate and competent surgical staff in each. During the succeeding year, however, there was a steady withdrawal of personnel from these stations. This permitted a considerable reduction of the surgical staffs and the release of officers for assignments overseas. The policy was then adopted of reducing to dispensary status the number of outlying station hospitals in the various harbor defense posts and concentrating the resulting excess medical officers in major station hospitals. With the opening of Waltham Regional Hospital, Waltham, Mass., on 1 February 1944, the hospital at Fort Banks was reduced to a dispensary status. At each of the retained station hospitals, it was necessary to keep a surgical staff competent in diagnosis and prepared to perform emergency operations and elective procedures of a nonformidable nature. The surgical staffs of the harbor defense hospitals maintained an excellent record of efficiency.

At Camp Myles Standish, Mass., there was maintained an active station hospital under the authority of the Boston Port of Embarkation. This hospital served a staging camp during a period of troop movements overseas. The census at the camp varied greatly between 5,000 and 30,000 troops. Patients from among these personnel in transit were, for the most part, suffering from training injuries and emergency ailments. During the early part of 1944, there were many patients suffering from chronic disabilities which made them unfit for oversea service. To remedy this situation, efforts were made to have the responsibility for the discovery of such conditions fixed definitely at the stations of origin. In the latter months of 1944, patients taken from shipments

because of hernia, pilonidal disease, internal derangements of the knee, and other chronic conditions appreciably lessened.

As the shipment of soldiers overseas diminished, there was a consistent decrease in the activity of this hospital. Accordingly, on 25 January 1945, the hospital at Camp Myles Standish was designated a debarkation hospital to replace the hospital at Camp Edwards, Mass. It continued to serve for the reception, temporary hospitalization, sorting, and redeployment of patients returned from oversea hospitals.

At the inception of the consultation service, large station hospitals were maintained at Camp Edwards and Fort Devens. Although both of these camps had passed the peak of their training activity, the hospitals were still fairly active and maintained full surgical staffs. The station hospital at Fort Devens had a 1,550-bed capacity, and on the occasion of the surgical consultant's first visit there were 589 patients. The hospital at Camp Edwards had 724 patients at this time, of whom 394 were surgical. The latter also hospitalized patients of the East Coast Processing Center, Camp Edwards.

The census at Edwards and Devens fluctuated considerably with a general trend downward. This permitted a reduction in the surgical staffs and the release of personnel for oversea service. On 15 July 1944, the station hospital at Fort Devens was assimilated as a part of Lovell General Hospital.[2] Some of the surgical staff of this station hospital joined Lovell, and others were used to augment the staff of the recently opened Waltham Regional Hospital.

On 24 July 1944, the station hospital at Camp Edwards was designated as a debarkation hospital. The hospital continued to serve in this capacity until 25 January 1945 when the debarkation function was taken over by the hospital at Camp Myles Standish. Camp Edwards Station Hospital was then redesignated as the U.S. Army General Hospital, Camp Edwards. Later, a hospital center was activated at Camp Edwards to administer the general hospital and the Camp Edwards Convalescent Hospital.

It was part of Colonel Cutler's earlier duties to visit hospitals at Army airfields. At the beginning of 1944, there were four airfields of the Air Transport Command three of which were located at Presque Isle, Houlton, and Bangor, Maine. The fourth was Grenier Field, Manchester, N.H. Hospitals of the First Air Force were at Bradley Field, Conn., and Westover Field, Mass. The functions of these hospitals were similar to those of the station hospitals of the ASF (Army Service Forces). They were prepared to deal quickly with severe casualties in considerable numbers resulting from a plane crash. There was set up in each an emergency room equipped with all needed instruments, dressings, splints, medication, laboratory apparatus, and plasma. Considerable ingenuity was employed in perfecting these arrangements and in the preparation of "crash bags" for use in the field.

A station hospital was also maintained at the Army Air Forces Technical School, New Haven, Conn. Most of the patients were students in training

[2] General Orders No. 124, Headquarters, First Service Command, 11 July 1944.

courses at Yale University and casuals in the New Haven area. In January 1945, the hospital was closed.

Consultation service was provided to these Air Force installations until the First Air Force called for its discontinuance. In May 1945, this service was resumed on an invitational basis. In all respects, except reporting, the service rendered to these hospitals was of precisely the same character as that accorded to hospitals of the Army Service Forces. Invitations to the consultants to visit these installations and requests for emergency consultation were frequent after May 1945 and were promptly responded to. The closest liaison was maintained with the Westover Regional Hospital at Westover Field, Chicopee Falls, Mass. This hospital maintained an efficient staff and functioned effectively.

On 27 June 1944, Waltham Regional Hospital was opened. It was designed to accept patients from all the outlying station hospitals. As the receiving hospital for the Boston metropolitan area, it took over the functions of the station hospital at Fort Banks. In addition, it hospitalized casuals in the area and dependents. The staff, strengthened by personnel transferred from the former Fort Banks and Fort Devens Station Hospitals, was organized as for a general hospital and dealt with all types of emergency and elective surgery.

Until the opening of Waltham Regional Hospital, Lovell General Hospital received all cases of major surgery occurring in the command, together with a few casualties from overseas. In February 1944, Lovell General Hospital—of wooden barracks construction—had 400 patients on the surgical services. Its staff, under Maj. (later Lt. Col.) Clifford H. Keene, MC, was of a high order of competence. There were sections of general surgery, orthopedic surgery, neurosurgery, urological surgery, and an active ear, nose, and throat service. Subsequently, neurosurgical and plastic work, as well as ophthalmologic surgery cases, were transferred to Cushing General Hospital, Framingham, Mass. Lovell continued throughout the war as a general hospital and received increasing numbers of oversea casualties. On 15 July 1944, Lovell General Hospital absorbed the Fort Devens Station Hospital. This additional capacity was quickly utilized, and at the close of the war Lovell General Hospital was operating with full wards.

Cushing General Hospital had not opened at the time of Colonel Cutler's arrival. Its staff, however, had been gathered and was being trained. On 25 January 1944, this hospital opened formally with Maj. (later Lt. Col.) Robert L. Mason, MC, as chief of surgery. At first, it received mostly cases originating within the Service Command. When oversea casualties began to be received in increasing numbers in the summer of 1944, the Zone of Interior patients were diverted to Waltham Regional Hospital. The accession of patients at Cushing General Hospital became more rapid with the designation of this hospital as a neurosurgical center and, subsequently, as a center for plastic surgery and ophthalmology.[3] Its bed capacity was

[3] War Department Circular No. 347, 25 Aug. 1944.

eventually expanded to 2,168, and it was rapidly filled and remained so at the close of hostilities.

EARLY CLINICAL PROBLEMS

Before the arrival of the consultant in surgery, each hospital commander determined the type of surgery which his staff was capable of performing. Occasionally, there were being undertaken at station hospitals formidable and elective operations on the intestinal tract and kidneys and orthopedic procedures such as bone grafting of fractures and the surgical care of internal derangements of the knee.

On 10 January 1944, War Department Circular No. 12 defined the policy of the War Department as to the transfer of patients to general hospitals. The circular stated that elective surgery of a formidable type is normally a function of general hospitals and that patients requiring such operations would be transferred to the nearest general hospital as soon as transportable. This changed the surgical services of the station hospitals considerably. There was at first some resentment on the part of the station hospital personnel at being deprived of valuable clinical material, but it soon came to be understood that the policy worked to the best interest of the patients.

The provisions of this circular necessitated some readjustment of surgical personnel. It became possible to strengthen considerably the surgical staffs of general hospitals by the transfer of competent surgeons from station hospitals as more and more of the general hospital surgeons were withdrawn by the requirements of oversea service. Besides, the policy assured the patients of more skillful management of their formidable surgical conditions, while it by no means deprived the station hospitals of a considerable number of problems with which their surgeons were qualified to deal.

The performance of operations for hernia in station hospitals was by no means uniform. One of the early activities of the surgical consultant was an effort to standardize the performance of this operation as outlined by the Office of the Surgeon General.[4]

The provisions of Circular Letter No. 72, Office of the Surgeon General, dated 17 March 1943, in regard to the treatment of varicose veins were also emphasized. A more judicious use of the methods of diagnosis and of treatment by ligation and injection was undertaken.

The provisions of Circular Letter No. 169, that patients with uninfected pilonidal cysts and sinuses should be operated upon, whenever possible, before infection occurred, had resulted in a considerable number of these operations. Almost universally, operation resulted in late healing and considerable loss of time and manpower.[5] Colonel Cutler surveyed this situation and analyzed 594 operations. The average length of hospitalization was 53 days. Primary

[4] Circular Letter No. 121, Office of the Surgeon General, U.S. Army, 13 July 1943.
[5] Circular Letter No. 169, Office of the Surgeon General, U.S. Army, 25 Sept. 1943.

union had failed in 23 percent of cases in which complete closure was done. The following statement was made by Colonel Cutler in a letter to General Rankin, dated 21 February 1944:

I have been greatly surprised to observe the large incidence of this condition among our troops. I believe that the fundamental congenital defect is a common one, but only in rare instances is it the source of sufficient inconvenience to the civilian patient to make him seek surgical relief. Infection of the sinus with abscess formation requires drainage. Repeated episodes of this sort lead to an extirpation of the source of trouble. Hence, in civil life, the surgeon sees only those cases which are complicated and troublesome.

Although the less cleanly life of combat troops may lead to a larger incidence of infected cases, I have no doubt that a great majority would go through a military experience with little more trouble than is encountered in civil life.

The extirpation of all discoverable pilonidal sinuses in the Army represents a policy of perfection, beneficial results of which are outweighed by loss of manpower.

Minor variations in technique make relatively little difference in the time required for healing, which, in most instances, is inordinately long—often thirty to ninety days. I advise against the tight-closure procedure. I feel sure that we shall see a good many recurrences. Even at this relatively early date, a number have been seen.

I believe that pilonidal sinus which does not produce active symptoms should be left alone. Infection should be dealt with by incision and drainage. One or more repetitions of infection should require the excision of the sinus with, at most, suture of the skin to the presacral fascia without attempt at side-to-side closure. I believe such a policy would certainly save a vast number of days of hospitalization.

On 2 September 1944, War Department Technical Bulletin (TB MED) 89 appeared, rescinding The Surgeon General's Circular Letter No. 169 and stating, "* * * true pilonidal cyst and sinus without purulent discharge, infection or history of acute abscess or inflammation will not be considered disqualifying for continued general military service, provided the condition does not interfere with the performance of the individual's duties in his military occupation specialty. Operation will not be performed in these cases, except as indicated in cases of infected cysts and sinuses."

Among the early clinical problems was that of persistent urethritis, both specific and nonspecific. There were many cases of gonorrheal urethritis which had proven resistant to sulfonamide therapy. Penicillin had not as yet come into general use for this condition. Some sulfa-resistant cases were being treated with fever therapy. While it appeared in some instances to be beneficial, fever therapy was decidedly unpopular with the victims and led to many problems of discipline. The procedure was also attended by some danger. The greater efficacy, speed, and safety of penicillin therapy proved a valuable change.

In the handling of nonspecific urethritis, penicillin proved less successful. There was a different method of treatment in almost every hospital visited. All of these measures seemed to be equally ineffective.

Three common types of injury occurred as a result of training activities or sports. They were sprained ankles, fractures of the carpal navicular bone, and internal derangements of the knee.

Sprained ankles were the most common injury. The orthopedists were about equally divided as to the relative efficacy of (1) rest with immobilization for a short time followed by walking with supporting strapping or (2) treatment by procaine hydrochloride (Novocain) injection and full unsupported use at once. The popularity of the latter treatment waned in favor of treatment by rest and support which came to be generally readopted.

Carpal navicular fractures were more common than Colles' fractures. No doubt a good many of these were missed and masqueraded as sprains of the wrist. A number were picked up when, on direction of the consultant, it became the rule to make four X-ray exposures of every injured wrist—anteroposition, lateral, and two oblique. Prolonged immobilization in the position of function produced almost uniformly excellent results.

Traumatic internal derangements of the knee, especially injuries of the semilunar fibrocartilages, were also encountered with some frequency. The policy of placing these cases in general hospitals was productive of better results. A factor in earlier recoveries was preoperative quadriceps exercise and its early resumption after operation.

One training hazard was a directed exercise in which a soldier, seated on the shoulders of a companion, wrestled with another, similarly mounted. This maneuver resulted in three fractured femurs within a 2-week period, and its discontinuance was recommended by the consultant. At about this time, injuries from supervised athletics and physical training exceeded 14 percent of all injuries from military accidents.[6]

As combat casualties began to appear at Lovell General Hospital, very satisfactory work had already been begun in the treatment of injuries of the soft parts and of the intestinal tract. There was still an inclination to treat compound fractures of long bones by the closed-plaster method or with dressings through windowed casts. The importance of knee mobilization and of the quadriceps exercises was not yet fully understood. Progress in the institution of skeletal traction was rapidly made, and special attention was given to the program for the activation of joints.

DEVELOPMENT OF THE GENERAL HOSPITALS

Lovell General Hospital

The gradually increasing influx of surgical patients from oversea theaters required the gradual expansion of Lovell General Hospital and its eventual absorption of Fort Devens Station Hospital. In February 1944 there were only 400 surgical beds occupied by patients at Lovell General Hospital, and by the end of August 1945 there were over 2,600 surgical patients. In August 1944, a reconditioning center at Fort Devens became a function of Lovell General Hospital and was designated Lovell East.

[6] Monthly Progress Report, Army Service Forces, War Department, 31 Jan. 1945, Section 16, Safety.

Additional medical officers were required for the expanded institution, and it was necessary to procure replacements for many of the staff transferred overseas. The chief of surgery, Colonel Keene, was transferred and Lt. Col. Ralph F. Bowers, MC, replaced him. The chief of orthopedics, the chief of urology, and the chief of eye service were also lost and replaced, as well as numerous assistant chiefs of sections and junior members of the staff. In spite of these changes, the professional efficiency was maintained at a high level.

At the suggestion of the surgical consultant, a surgical clinical conference was held at Lovell General Hospital on 30 March 1944. To this were invited the personnel of Army and Navy hospitals and a number of civilian doctors. Over 400 officers and doctors attended, as did the service command surgeon and the commanding general. The staff conducted rounds and demonstrations. There was an exhibit of clinical material which included bone grafting, a demonstration of penicillin therapy, the use of tantalum, and the production of prosthetic dental appliances. Papers and cases were presented. This conference was of great value in establishing a pleasant liaison among neighboring hospitals, with the Navy, and with the civilian profession. It served to unite the members of the surgical services in a common effort.

Lovell General Hospital joined Cushing General Hospital and the medical service of the First Naval District in presenting an exhibit on military surgery at the meeting of the Massachusetts Medical Society on 23 and 24 May of the same year.

Cushing General Hospital

At Cushing General Hospital, growth of the surgical service developed particularly in the sections in neurosurgery, plastic surgery, and ophthalmology, for which specialties it was designated by the War Department as a special treatment facility.[7] The reception of patients within these special fields required the maintenance of a general surgical service of modest proportions and an orthopedic section of considerable magnitude, since most of the patients presented concurrent orthopedic problems. Fractures and osteomyelitis were common in the neurosurgical patients. Many patients presented problems of plastic, orthopedic, and neurological surgery combined.

Since these patients required the attention of more than one section, the surgical consultant suggested the arrangement of a system of regular intersectional conferences. By this means, a complete therapeutic program was laid out for each patient. Progress of patients was noted and transfers were arranged as necessary between the sections. This system was put into effect while there were still but few patients in the hospital. Its value became apparent as the hospital filled, and it proved an effective means of managing the interrelated problems of the various sections.

There tended to be an overlapping of the activities of the section of neurosurgery and the neurological section of the medical service. A plan was pro-

[7] War Department Circular No. 347, 25 Aug. 1944.

posed and adopted on 18 August 1944 which provided that the neurological section of the medical service and the neurosurgical section of the surgical service work in concert. Free consultations were arranged between the medical neurologist and the neurosurgeon for the evaluation, treatment, and distribution of cases. The neurosurgical patients were thenceforward admitted to the neurological section of the medical service, where diagnosis was accomplished. Surgical patients were then transferred to the neurosurgical section for operation and immediate aftercare and were transferred once more to the neurological section for further treatment. This plan permitted the medical neurological section to perform its functions of investigation, appraisal, and treatment, meanwhile relieving the neurosurgical section of this burden. This system worked to the satisfaction of all concerned. This plan, successfully instituted at Cushing General Hospital and communicated to General Rankin by Colonel Cutler, became one of three plans authorized for the management of neurosurgical cases as set forth in a letter from Brig. Gen. Raymond W. Bliss on 25 January 1945 to the Surgeon, First Service Command.

Provision was made for the specific care of spinal cord injuries. A special ward had been set up for their accommodation, with a special program of restoration of nutrition, care of infected bladders and bedsores, and for the beginning of rehabilitation. By November of 1944, this ward was in full operation with 26 patients, and by September 1945 there were 88 paraplegic cases. Messing facilities, gymnasium, physiotherapy room, recreation room, and wards sufficient to accommodate all of the paraplegic patients were established in a separate group of buildings.

The plastic section was opened on 23 September 1944 by the transfer of personnel and some equipment from Bushnell General Hospital, Brigham City, Utah. Before this arrival, there had appeared on the neurosurgical section an increasing number of injuries and deformities of the hand. Because of the special nature of these injuries, and because of the need of many of them for plastic procedures, the surgical consultant recommended that such cases be cared for as a special group with ward space allotted to them specifically under the plastic section. In early October 1944, the hand cases were placed in charge of a special officer working in this section. He received consultation advice and assistance in operating, as required, from the chief of neurosurgery, the chief of orthopedics, the chief of plastic surgery, and the surgical consultant. At the close of hostilities, there were 150 patients in the subsection for hand surgery. In early December 1944, Dr. Sterling Bunnell, Civilian Consultant to The Surgeon General for Hand Surgery, spent 5 days at the hospital evaluating patients, operating, and instructing officers in charge of the hand section.

The author suggested to The Surgeon General that all hand cases requiring formidable surgical reparative procedures be congregated in special hospitals. On 21 December 1944, a letter was received from The Surgeon General informing Colonel Cutler that all reconstruction hand cases would in the

future be sent to plastic centers. This provision undoubtedly worked to the great benefit of patients suffering from hand injuries.

Cushing General Hospital was also designated as a center for ophthalmology by War Department Circular No. 347, 25 August 1944, necessitating assignment of trained ophthalmologists. Its activities at first were confined to ophthalmic procedures in association with the plastic section. In November 1944, there were but 24 patients in the ophthalmology section. Eight months later, its patients numbered 103, and the program for the production of acrylic eyes was well underway. By the end of the war, the ophthalmology section had 140 patients.

Colonel Mason continued as chief of surgery until May 1945, being replaced by Col. Horatio Rogers, MC. While a number of the junior officers were released for oversea assignment, the chiefs of sections remained. This permitted the maintenance of a closely integrated service such as is required by a multiple specialty center.

Camp Edwards General Hospital

The hospital at Camp Edwards served as a station hospital until 24 July 1944. On that date it became a debarkation hospital and, until its designation as a general hospital, its staff was busied with the reception, evaluation, treatment, sorting, and reshipment of all patients arriving at the port of Boston. This change of function from a station hospital to a debarkation hospital required readjustment of the staff, rearrangement of the surgical service for its new duties, and certain changes in personnel. Doctors to travel on hospital trains to various parts of the country were furnished from the staff of the Camp Edwards Debarkation Hospital. During its active period, the debarkation hospital at Edwards was handling between three and five thousand patients per month.

When the debarkation activities were taken over by the hospital at Camp Myles Standish, it was necessary rather rapidly to readjust Edwards to fulfill the functions of a general hospital. Major changes of plan and personnel were required. During the period of change, there were three changes in the chief of surgical service. Lt. Col. William A. Mahoney, MC, was succeeded by Maj. Joy K. Donaldson, MC, who was succeeded in turn by Col. Edwin F. Cave, MC. The chiefs of orthopedic section and of general surgery were also changed twice during this period. By early September 1945, the hospital, at 3,200-bed capacity, was caring for 1,158 patients on its surgical services.

DEBARKATION ACTIVITIES

At Camp Edwards, the large station hospital designated on 24 July 1944 as a debarkation hospital was eminently suited to the purpose by reason of its accessibility to the port of Boston. To it were brought frequent shipments of oversea casualties, numbering from 200 to 500 at a time. Hospital trains

brought patients from ship to ward in about 4 hours. When hospital cars were used, the placement of patients on the train could be quite rapidly and comfortably effected. When Pullman sleepers made up the train, it was necessary to remove windows to permit the loading of the stretchers. This slowed down the loading considerably and presented great difficulty in the handling of patients in body casts and spicas. The personnel of the port of debarkation acquired considerable skill and efficiency in the movement of patients in spite of these handicaps.

At the Camp Edwards end, unloading platforms were provided and the adjacent warehouses, now empty, were used for the reception of patients. Prisoners of war from the stockade at Camp Edwards were effectively employed as litter bearers.

The first shipment of wounded arrived on 27 July 1944. These consisted of wounded German prisoners recently evacuated from the battles of Normandy. There were 297, of whom 168 were litter patients. Many had had no changes of dressing since the initial debridement. Most of them had been wounded about 2 weeks before their shipment. The procedure followed was typical of that followed in subsequent shipments.

Rounds had been made by surgeons on the train en route from the port, and the patients had received food. They were taken by ambulances to the hospital, about a mile distant, and were moved to their beds. Each ward was occupied half by litter patients and half by ambulant patients. The ambulant patients aided with the care and feeding of those confined to bed. The patients were bathed and furnished fresh bedwear, and temperatures were taken. Ward officers inspected each patient, and the chief of surgery then visited those who required attention.

After a night's rest for the patients, complete rounds were made. Wounds were inspected and cleansed. Fresh dressings were applied. Casts were inspected and removed from patients with elevation of temperature. Casts were also removed when they were constricting, were broken, loosened or softened by discharges, showed evidence of bleeding, or were painful. Determination was made as to which patients could be safely and comfortably transported to their ultimate destination. The hospital decided to retain but 6 of the first 168 litter cases.

In spite of the fact that no other care had been administered than that received in the first evacuation hospital, the wounds in general were in excellent condition, although the dressings were much soiled. About 25 percent of the casts required removal and replacement. Many were saturated with pus, and all were malodorous. Pressure sores were notably lacking. Among the six patients to be retained were two with active cellulitis following compound fractures. In one there was an abscess in the fascial planes of the forearm, and the other had a wound of the thigh in which tight packing had impounded pus.

The generally satisfactory condition of the patients, the healthy aspect of most of the wounds, and the infrequency of complications through a journey of 2 weeks' duration were noteworthy. Even the major injuries of compound comminuted fractures of the long bones had carried very well in plaster. Patients who were not transportable were treated further at the hospital at Camp Edwards or were transferred to one of the nearby general hospitals.

Following the period of treatment and sorting at the debarkation hospital, the patients were shipped to the hospitals of eventual destination.

During debarkation activities, but three deaths occurred. Two German prisoners of war suffering from empyema were transferred to Lovell General Hospital and died there. One ambulant medical patient died suddenly from embolism while in transit to a hospital in the interior.

Following the designation of the Camp Edwards debarkation hospital as a general hospital, debarkation activities were transferred to Camp Myles Standish. There, the procedure was essentially the same. At the close of the war, this hospital was still functioning as a debarkation hospital. The total number of patients passing through Camp Edwards debarkation hospital was 17,437. The hospital at Camp Myles Standish handled 22,016 evacuees.[8]

SURGERY IN THE PRISON CAMPS

The ships which brought in prisoner-of-war wounded also brought considerable numbers of healthy German prisoners. They were distributed to prisoner-of-war camps in northern New England and utilized in the logging industry and the cultivation of potatoes. Prison camps were established in New Hampshire at Camp Stark and in Maine at Houlton, Princeton, Seboomook, and Spencer Lake.[9] In addition, there were stockades at the Army airfield at Presque Isle, at Camp Edwards, and at Fort Devens.

Where hospitals were nearby, as at Camp Edwards and Fort Devens, stockade dispensaries filled the need for medical care. Patients requiring hospitalization were transferred to the adjacent hospitals. In the more remote areas, injuries were found to be more frequent and often severe. These injuries consisted usually of ax and saw wounds of the legs, arms, and hands and closed fractures. There were a number of surgical emergencies, notably acute otitis media and mastoiditis, perforated peptic ulcer, intestinal obstruction, and appendicitis.

For these emergencies in the remote lumber camps, arrangements were made with local civil hospitals to which the patients could be transported. The towns nearest to Seboomook Lake and Spencer Lake were between 50 and 65 miles away. It was therefore recommended that surgeons be supplied to these remote camps who were competent to deal with such emergencies. Dur-

[8] Report, Hospitalization Section, Office of the Surgeon, First Service Command, 15 Sept. 1945.
[9] Annual Report, First Service Command Medical Activities, 1944.

ing the subsequent winter, several patients with acute appendicitis and one with peptic ulcer perforation were successfully operated upon at these camps.

It was found that many of the prisoners at remote camps were suffering from unhealed osteomyelitis, chronic otitis, peptic ulcers, and hernias which threatened strangulation. It was recommended that more careful medical screening be done at the port before assignment of prisoners, and, when disabilities threatened the development of surgical emergencies, the prisoners were to be assigned to stockades close to general hospitals. This suggestion was carried out, and all prisoners suffering from threatening disabilities were removed from the prison camps in the remote districts.

PROGRESS OF SURGICAL CARE

Surgical emergencies were encountered and dealt with at all hospitals. There was no fatal case of appendicitis or of perforated peptic ulcer within the service command during the author's tenure as the surgical consultant. Nonformidable surgical procedures of an elective character were carried out in station hospitals as permitted by directive. In the Waltham Regional Hospital, as in the regional hospital at Westover Field, cholecystitis, goiter, malignancies of the stomach and large intestine, ulcerative colitis, and recurrent hernia were encountered. Lt. Col. Benjamin S. Custer, MC, at Westover Field, Lt. Col. George A. Marks, MC, at Waltham, and their staffs dealt with these surgical conditions with sound judgment and skill and with satisfactory results.

Abdominal Surgery

In the general hospitals, problems peculiar to the injuries of war were met, and progress and improvement were made in their treatment. Among these problems were intestinal injuries which sometimes presented simple colostomies or enterostomies; were sometimes complicated by injuries of the pelvic bones, the chest, the bladder, the perineum and rectum; or were associated with remote fecal fistulas to the skin and the urinary tract. Colonel Keene, chief of surgery at Lovell General Hospital, developed a considerable interest in the care of these patients with abdominal injuries. The procedures that he developed in caring for an initial group of 40 cases were observed by the consultant.[10] Assured of the soundness of Colonel Keene's procedures, Colonel Cutler advised their adoption in the other two general hospitals.

In patients in which spurred colostomies had been made at the initial operation there were found reversal of the spurs, interposition of omentum or mesentery, and the involvement of loops of small intestines in adhesions about the spurs. Operative investigation by completely freeing the extruded bowel from the wound and its dissection within the abdomen clearly demonstrated the hazard of spur clamping by reason of unsuspected complications.

[10] Keene, C. H.: Reconstruction of Wounds of the Colon. Surg., Gynec. & Obst. 79: 544–551. November 1944.

It became the practice to separate the limbs of the spur and to close the bowel opening by appropriate suture or to resect the involved portion of the gut by performing an end-to-end anastomosis of the large bowel. Such repairs were then dropped back within the abdomen. Simple loop colostomies were similarly dealt with.

One hundred and four such operations were done in the three general hospitals according to this plan. Eighty-eight healed and remained closed. There was one death from peritonitis.

When complicating injuries of bone or urinary tract, fecal fistulas from the distal portion of the large intestine, or injuries of the rectum or perineum were encountered, transverse colostomies of an obstructing type were done. Devine colostomies first employed appeared to have no advantage over the simple divided colostomy. Once the fecal stream was completely diverted and appropriate incision and drainage or sequestrectomy or repair of the urinary tract done, healing was relatively rapid. Closure of the initial colostomy was then done, followed by closure of the secondary obstructing colostomy.

Orthopedic Surgery

In the general hospitals, treatment of bony injuries was pursued according to directive. In the suspension traction treatment of fractures of the femur, it was interesting to Colonel Cutler to note an increasing tendency to place the Kirschner wire through the tibial tubercle rather than through the condyles of the femur. The orthopedic surgeons agreed that, when the traction was so employed, the knee joint was less jeopardized and the quadriceps exercises were better performed. Movement of the knee joint with the Pierson extension was apparently little interfered with by the tibial placement of the wire.

The treatment of osteomyelitis underwent considerable change. In the earlier days, there was a tendency toward closed-plaster treatment. Later, the wounds were treated by open method and appropriate traction was applied for the underlying fracture. At Cushing General Hospital osteomyelitis was treated by a complete sequestrectomy followed by daily open dressing of the wounds. After trying a number of materials, the orthopedic section settled upon penicillin solution on gauze as being the best dressing. The wounds granulated rapidly, but slow epithelization often delayed needed nerve repair.

Early in 1945, Colonel Cutler recommended the trial of early skin grafting of these granulating osteomyelitis wounds following sequestrectomy. The results demonstrated at Newton D. Baker General Hospital on 11 and 12 May 1945 fully confirmed the validity of this proposal.[11] Following careful sequestrectomy, dermatome skin grafts were applied between 1 and 2 weeks after operation. This procedure was made standard in all of the hospitals of the service command.

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[11] Urological Conference and Symposium on the Paralyzed Patient at Newton D. Baker General Hospital (Martinsburg, W. Va.), 11–12 May 1945, pp. 65–79.

In deep-lying osteomyelitis following early sequestrectomy, wounds were left open. First at Lovell General Hospital as early as June 1944, and subsequently at Cushing, an attempt at closure of these wounds at the time of sequestrectomy was begun. Penicillin, the use of which had formally been approved in February 1944,[12] was used systemically before and after operation. Penicillin solution (1500 units per cc.) was also used to irrigate the depths of the wounds through catheters inserted at the time of operation. That the local use of this drug contributed to the success of the treatment was doubtful.

On 22 January 1945, Dr. Marius N. Smith-Petersen, Civilian Consultant in Orthopedic Surgery to The Surgeon General, visited Cushing General Hospital. He proposed that metallic cannulas instead of catheters be inserted at the time of sequestrectomy. Through these cannulas, penicillin solution was to be injected at intervals of 2 or 3 hours until the discharge had lost its purulent character. The cannulas were then to be withdrawn from the wound, the scar was to be excised, and complete resuture of the wound was to be done. By the middle of September 1945, 53 cases had been treated by this method. Of the 41 completed cases, 35 had been closed and remained closed. The average duration of treatment, from sequestrectomy to complete closure of the skin, was 31 days.

Dr. Smith-Petersen believed that it was possible, with the aid of systemic and local penicillin, to obliterate major bone defects by collapsing osteotomies at the time of sequestrectomy or subsequently in the presence of granulating wounds. He suggested that, even in the process of osteomyelitis or granulating wounds, it was possible and safe to perform arthrodesis. In six such operations performed, there were no untoward results.

As a result of his teaching, the performance of operations of bone reconstruction was undertaken at an earlier date following the healing of osteomyelitis than had hitherto been thought safe. This policy materially shortened hospitalization and permitted the earlier repair of injured peripheral nerves.

Lovell General Hospital, which received the earlier casualties, admitted eight patients who had been treated by the application of metal plates to fractures of the long bones in the oversea theaters from which they had been evacuated. Six of these had nonunion and loosened plates with distraction or absorption at the bone ends. The plates had to be removed and traction suspension instituted. Six cases were seen with fractures splinted by external skeletal fixation. With but one exception, these cases showed absorption at the pinholes, and they had open draining sinuses. During these early months, a number of patients were received whose condition of depletion from prolonged sepsis required the postponement of any operative procedure for several weeks. It was believed that some of these might have benefited by longer hospitalization abroad with more attention to supportive treatment. Among the depleted cases were four American wounded who had been held prisoners. Their open fractures of the femur had been treated by German surgeons with intramedullary

[12] War Department Technical Bulletin (TB Med) 9, 12 Feb. 1944.

pinning (Küntscher nails). All were suppurating, and the nails, which were the first to be seen by the hospital staffs, had to be withdrawn.

Combined Bone and Nerve Injuries

At Cushing General Hospital, as a result of intersectional conferences, it was often possible to combine the procedures of orthopedists and neurosurgeons. Thus, when bone grafts were required in patients with divided peripheral nerves, exposure of the site was carried out by the orthopedist who, while repair of the nerve was being done by the neurosurgeon, made ready the bone graft and subsequently applied it to the fracture. When the nerve ends could not readily be united, the orthopedic surgeon performed appropriate shortening of bone.

Neurosurgery

Restoring peripheral nerves following injury furnished the bulk of the work of the neurosurgery section. At first, tantalum wire sutures and protecting tantalum foil cuffs were used in the uniting of nerves. In the early months of 1945, however, a number of cases were observed in which the tantalum cuff had fragmented with considerable scar tissue in and around the fragments. The use of tantalum foil was therefore discontinued.

By 27 June 1944, frozen nerve grafts had been arranged for with Dr. Frank Ingraham of Harvard University. This work was encouraged by Dr. Jason Mixter, Civilian Consultant in Neurosurgery to The Surgeon General. By September 1945, Lt. Col. William P. Van Wagenen, MC, Chief, Neurosurgery, Surgical Service, was able to report no satisfactory results from donor grafts.

When the satisfactory restitution of peripheral nerves failed, the orthopedic section was called to perform the appropriate tendon transplantations. In some of the cases of footdrop, a wedge of tibia was formed and placed in the posterior talus to prevent plantar flexion of the foot beyond right angles.

In skull and brain injury, removal of the irregular edges of the damaged skull, careful excision of the scarred and adherent dura, and freeing of the underlying brain cortex were done. Repair of the dural defects, originally performed with fascia lata, was later done with fibrin film. The defects in the skull were repaired with shaped tantalum plates.

Also treated were a number of cases of brain and spinal cord tumor. Operations on the spine for herniated nucleus pulposus were rarely applicable to Army personnel with any prospect of return to active duty, and few of these operations were performed.

Care of Paraplegic Patients

At the close of hostilities, 88 paraplegic patients were under treatement. At the time of their reception, they were emaciated, anemic, and incontinent; evidenced profound avitaminosis and suprapubic cystostomies; were afflicted

with large decubitus ulcers; and were in a low state of morale. They were placed in one ward with specially trained attendants and nurses.

At first, it was thought necessary to keep these patients in bed during the treatment of their bladder infection and to maintain the suprapubic cystostomies for long periods of time. Later, it became apparent that these patients could be out of bed earlier and that the suprapubic drainage could be replaced by urethral catheter at an early date. This revised program began in June 1945.

Irrigations of the bladder at 2-hour intervals were continued until cystometric examination revealed diminution of spasticity. At this time, tidal drainage was instituted and was continued until the suprapubic opening was closed and automatic bladder function had been established. This became part of a detailed standard plan of management.

Operative treatment of the decubitus ulcers was undertaken. At operation, the ulcer was excised with complete undercutting of the skin and subcutaneous tissue. Closure of the defect was performed in two layers, the deep fascia and the skin. The stitches were left in place for 21 days. Ulcers as large as 12 cm. in diameter were successfully healed. Over 50 such operations were done, and 60 percent of the bedsores closed by suture remained healed on the first attempt.

As decubitus ulcers were closed, the nutrition and morale of the patients improved with greater rapidity. Regular exercising of the unparalyzed muscles of the upper body was carried on assiduously from the start and patients were permitted to be in wheelchairs and were given instruction in walking. In July of 1945, an instructor was secured from the Institute for the Crippled and Disabled in New York to direct this training.

Urological Surgery

The work of the urological surgeons, in addition to the treatment of bladder complications of spinal cord injuries, consisted in the care of congenital and acquired anomalies and infections of the urinary tract. There were also cases of kidney lacerations by gunshot wounds and fistulas of the ureter or of the bladder to the surface or to the abdominal viscera. Such injuries were often associated with osteomyelitis of the pelvic bones or hip, injuries of the penis, and perineal urethra.

Typical of the cases of injury of the ureter was one at Lovell General Hospital in which the left ureter had been damaged 2 cm. from the bladder by a bullet which had entered the coccygeal region and had passed through the rectum and bladder. Urine drained through the coccygeal sinus together with fecal material. There was a chronic abscess and pyonephrosis. Nephrostomy was followed by resection of the damaged portion of ureter and ureteral anastomosis. The result was satisfactory. Injuries with fistulas and osteomyelitis of the pelvic bones were successfully treated by diverting colostomy

and subsequent local surgical attention. One case of obliterative scarring of the membranous portion of the urethra required perineal reconstruction of the urethra.

Most of the urological work of a formidable nature was carried on at either Lovell or Cushing General Hospitals. The surgical consultant recommended that in each of the hospitals the urologist institute an active program for the detection of stones forming in the urinary tract, especially in patients long bedridden and taking sulfonamide drugs.

Plastic and Hand Surgery

Cushing General Hospital was designated as a center for plastic surgery in August 1944. Before this, it had been the practice at Lovell General Hospital to cover bone injuries in preparation for bone grafting. It was apparent to the surgical consultant that the required policy of sending such cases to the special plastic center as Cushing General Hospital would interrupt the course of treatment, involve longer hospitalization, and unduly burden the plastic section at Cushing. This point of view was communicated to General Rankin, who approved the practice of performing these simpler plastic procedures at general hospitals. Thus, the covering of bone injuries by skin grafts was carried on at Lovell and subsequently at Camp Edwards General Hospital. It proved to be a satisfactory method of handling these cases.

By the middle of September 1945, the plastic section at Cushing General Hospital was caring for 306 patients. Very successful work was done in the resurfacing required by severe scars, the transfer of tube grafts in preparation for further orthopedic surgery, the repair of severe burn contractures, and reconstructive work about the hands, neck, and face. This work was carried on in close cooperation with the sections of ophthalmology, otolaryngology, and dentistry. One case in particular, lacking the entire mandible below the angles, was brought far on the road to presentable restitution. This section profited by the visits of Dr. Jerome P. Webster and Dr. Robert H. Ivy on 23 and 24 May 1945.

The subsection on surgery of the hand instituted under the plastic section, Cushing General Hospital, in October 1944 had its own officer in charge, Capt. James W. Littler, MC. He received instruction and assistance from the neurosurgeon, the orthopedic surgeon, the plastic surgeon, and the surgical consultant as required. On 1 December 1944, Dr. Sterling Bunnell, Consultant in Hand Surgery to The Surgeon General, came to Cushing General Hospital for a 5-day visit, his first official visit to an army hospital. He held clinics and demonstrations, operated with the officers in care of these hand cases, and instructed them in operating technique.

The hand surgeons held regular consultation conferences weekly with neurosurgeons, plastic surgeons, and orthopedists. The officers in the hand surgery subsection rapidly developed the ability to carry on this work on a specialty basis with less and less assistance from the other specialists. Success-

fully accomplished were tendon transplants and grafts, peripheral nerve sutures, reactivation of joints by corrective splinting and capsulotomy, skin resurfacing, corrective osteotomies, transplantations of rays, and correction of nonunion and malunion of the metacarpals and phalanges. Doweled tibial grafts were skillfully used to restore length and stability to damaged long bones. Successful arthroplasties employing tantalum cups of the metacarpophalangeal joints were done. The results of these operations were gratifying. By 12 September 1945, there were 200 patients under treatment in this subsection.

Eye, Ear, Nose, Throat Surgery

Since the work of the plastic section involved reparative and reconstructive surgery of the upper respiratory passages, otorhinolaryngologists having plastic surgery experience were placed in the section. At the other hospitals, otorhinolaryngologists were required for the carrying on of routine treatment of infections and abnormalities of the ears, nose, and throat. There were found a good many soldiers suffering with chronic otitis media resistant to treatment. It was found that underlying mastoid involvement was often responsible, and mastoidectomies were performed in the general hospitals and in the regional hospital at Waltham.

At the general hospitals, eye specialists were also maintained for the care of injuries and infections of the eye. At the station and regional hospitals, ophthalmologic specialists performed refractions and the fitting of glasses, as well as routine eye examinations.

After the opening of the ophthalmology section at Cushing General Hospital in August 1944, the ophthalomologists were busied with work about the orbit involved in plastic procedures. The major activity of this section consisted in enucleation or revision of enucleation for the fitting of acrylic eyes. The ophthalmologists expressed the opinion that an earlier revision shortly following injury would be productive of better ultimate results. The production of acrylic eyes was successfully carried on.

Among the conditions treated by the ophthalmologist were foreign bodies embedded in the eye, choroiditis, traumatic cataract, and retinal separation.

Among the interesting ear, nose, and throat cases seen at Cushing General Hospital were two of gunshot injuries of the trachea and the esophagus, both of which made a satisfactory recovery. At Lovell General Hospital, several cases of advanced suppurative sinusitis were treated, two with osteomyelitis of the frontal bone. Sequestrectomy and subsequent replacement of skull defects with tantalum plates brought about satisfactory recovery.

Gynecology and Obstetrics

For the care of the WAC's (Women's Army Corps), nurses, and female civilian dependents, gynecology was done on an outpatient basis at station hospitals, operative cases being transferred to Lovell General Hospital or Waltham

Regional Hospital. Obstetrical practice was also carried on at the latter two hospitals.

Operating Rooms

It was the duty of the surgical consultant to note operating-room equipment, procedures, and technique. Equipment was usually found to be satisfactory. At Waltham and Cushing, holophane lights were unsatisfactory and were replaced by Castle or multibeam lights.

Technical procedures were corrected as occasion required. There was a tendency to place superfluous furnishings in operating rooms. These were removed on recommendation. The presence of surplus and unauthorized instruments was checked on the request of the Director, Surgery Division, Office of the Surgeon General.

It was necessary to make sure that operating-room facilities were being used to full capacity. It was the duty of the anesthesiologists to maintain a satisfactory operating-room program. At Lovell General Hospital, operating facilities became very much crowded, but this was relieved by the opening of Lovell Hospital North. At Cushing General Hospital, there developed a backlog of surgical cases, and it was recommended that the operating-room facilities be increased by new construction.

Anesthesia

It was possible to maintain officers competent in anesthesia at all hospitals. Reports on anesthesia were made to the Director, Surgical Consultants Division, Office of the Surgeon General, on 1 August 1944 and 20 October 1944. These reports showed anesthesia practices in the command to be satisfactory and the equipment, adequate. It was the practice to utilize spinal and local anesthesia very largely in the station hospitals. At Waltham Regional Hospital and at the general hospitals, fully qualified anesthesiologists were maintained. Schools for nurse anesthetists were also established at these hospitals.

The use of spinal anesthesia became less common in formidable surgical cases. A gas-oxygen-ether sequence for these cases was generally preferred. Occasionally, Penthothal sodium (thiopental sodium) was used and gave complete satisfaction. Continuous spinal anesthesia proved satisfactory. There were no anesthetic accidents.

Among the functions of the chiefs of anesthesia was the management of the recovery wards. These wards were maintained in all the general hospitals and proved completely satisfactory. Air-conditioning of the operating rooms at Cushing General Hospital contributed greatly to the comfort of the surgeons and the welfare of the patients.

Central Supply Service

A central supply service was also under control of the anesthesiologists and chiefs of operating rooms. The program for their installation was recommended by the consultant in June 1944. The establishment of this type of

service was confirmed and outlined in April 1944.[13] Difficulty and delay in establishment of these services was due to lack of adequate space. At Cushing General Hospital, a room which had been provided was too small. At Lovell General Hospital, at Waltham Regional Hospital, and at the Camp Edwards hospital, no such provision was originally made. At Lovell, authorization for necessary construction was requested on 24 April 1944, and the system was put into effective operation in May 1945. The activities of the central supply service system in this hospital were complicated by the system's division into two active units, Lovell North and Lovell South. At Waltham Regional Hospital, additional construction was not completed until July 1945. Until that time, the operating room furnished the necessary supplies. At Camp Edwards, request for construction was made on 27 April 1944, but at the close of hostilities construction was still underway. Where the central supply service was put into operation, its great value was recognized.

Orthopedic Braceshops

Orthopedic braceshops were part of the original equipment of Cushing and Lovell General Hospitals. These facilities made splints and braces for all installations of the command. As the workload increased, delays resulted. In August 1944, it was recommended that a braceshop be installed at Waltham Regional Hospital for its own use and that of the neighboring station hospitals. The construction was authorized, and the shop started effective operation in January 1945. At Camp Edwards, a braceshop, authorized in February 1945, was not put into operation until July 1945.

At Lovell and Cushing General Hospitals, civilian bracemakers were employed and assisted by technicians whom they trained. It was necessary to arrange with the Personnel Division, Headquarters, First Service Command, to protect this scarce category of trained enlisted men from loss by transfer. At Cushing, because of the need for supporting apparatus for paraplegics and neurosurgical cases and for the corrective splinting of hand injuries, the work was extensive. Many of the splints used were especially designed for particular problems and could not be produced in bulk.

In the orthopedic clinics, one of the most frequent problems was that of flat feet. The ARCH-O-GRAPH equipment proved unsatisfactory. The arches would not stand up under conditions of active use. Consequently, a program for fitted metallic arches was developed.

Major deformities of the feet required the production of special shoes beyond the capacity of the orthopedic shops. The laboratories of the United Shoe Machinery Company had perfected a device for securing impressions of such deformed feet and a process for producing shoes to fit them. The Surgeon General authorized the trial establishment of the process in the First

[13] War Department Memorandum No. W 40-44, 12 Apr. 1944.

Service Command under the Boston Quartermaster Depot.[14] The surgical consultant was charged with the arranging of the program, which was put into effect at once. An orthopedic surgeon, Capt. Saul Steinberg, MC, was assigned to the Boston Quartermaster Depot for instruction and research in specially built shoes. Captain Steinberg was also to work with the Lawrence Climatic Research Laboratory in other shoe investigations.

Physical Therapy

Physical therapy functioned in cooperation with all sections in the hospitals, particularly with the sections of orthopedics, under the supervision of which it operated. There were a sufficient number of whirlpool baths, electric heat apparatuses, infrared and ultraviolet lamps, and treatment tables. Physical therapy aides, enlisted technicians, and WAC personnel carried on most of the treatments. Medical officer physiotherapists were available at Lovell and at Cushing. Ward buildings lent themselves poorly to the needs of a physiotherapy department. Removal of partitions and elimination of small rooms, providing a large open space, were effected at Lovell and Cushing, much to the advantage of the service. At Cushing, authorization was requested for the enlargement of the building. At Lovell General Hospital, it was necessary to establish a second physical therapy department in Lovell North.

Between 400 and 500 treatments were given daily at Lovell General Hospital. At Cushing, more than 600 treatments were provided per day. There was a combined total of 17,373 treatments during the month of August 1945. At Camp Edwards Convalescent Hospital, where during the summer of 1945 between 4,000 and 5,000 patients were accommodated, a building was provided and staffed for the treatment of between 200 and 300 patients daily.

The policy of the surgical consultant was to emphasize the importance of employing manipulative physical therapy judiciously, intelligently, and sparingly. Emphasis was consistently placed on remedial and corrective exercises rather than on baking, massage, and manipulation. There was a tendency to refer patients for physical therapy for the patient's satisfaction and the relief of the surgeon without due regard to the specific needs of the individual. It was insisted that a specific prescription for treatment should be worked out for each patient and that periodic evaluation of the case should be made.

Exercises were instituted even for patients in bed. Attached to each of the physiotherapy departments was a gymnasium equipped with apparatus for remedial exercising. Directed exercises for the paraplegic cases at Cushing General Hospital were undertaken while the patients were still in bed and were carried on later in a special physiotherapy department attached to their own wards.

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[14] Letter, The Surgeon General to Commanding General, Headquarters, First Service Command, Boston, Mass., attention: Surgeon, 24 Jan. 1945, subject: Study of Special Shoes at The Boston Quartermaster Depot.

Occupational Therapy

Occupational therapy was designed to restore the strength and usefulness of injured extremities by the performance of useful tasks which might have training or recreational value. The work prescribed for the individual was designed to fit his needs. At the general hospitals, and also at Camp Edwards Convalescent Hospital, shops were set up for this. At Lovell, under Capt. Sidney Licht, tools with graded handles, looms, printing presses, leg- or foot-operated bandsaws and jigsaws, all with adjustable fixtures, provided graduated range of motion. Here, also, were employed planing, handsawing, painting, weaving, and sandpapering. Use of the piano and instruction proved valuable for patients suffering from upper extremity disabilities.

Summary

Surgical care, in all its phases, resulted in 11,063 battle casualties' (surgical) being admitted to First Service Command hospitals between 1 January and 1 July 1945 for definitive treatment. Deaths numbered nine, or 0.08 percent, somewhat less than one per thousand.

CONVALESCENT PROGRAM

The reconditioning program was established and its policies were outlined by Circular Letter No. 168, Office of the Surgeon General, dated 21 September 1943. A reconditioning officer was appointed at First Service Command headquarters, and the surgical consultant was ordered to act as consultant in reconditioning. The surgical consultant visited the reconditioning center of the Second Service Command at Atlantic City, N.J., on 31 January 1944. On 24 and 25 April 1944, he attended a reconditioning conference at Halloran General Hospital, Staten Island, N.Y., and at Thomas M. England General Hospital, Atlantic City, N.J. Some of the recommended procedures were adopted in the First Service Command.

The reconditioning program was carried on in hospitals until April 1944 when a reconditioning center was set up in barracks at Fort Devens for Classes I and II patients.[15] This activity continued as a part of Lovell General and Convalescent Hospital until 25 January 1945, at which time the convalescent hospital was opened at the U.S. Army Medical Center, Camp Edwards.

Before its opening, a principle was proposed by the surgical consultant which was adopted. This policy provided that beyond a certain point of recovery Class I and II patients should be separated into two groups, as follows: (1) Those who would return to duty as soldiers and (2) those who were to be separated from the service by certificate of disability for discharge. The two groups thence forward were to pursue separate programs predicated on their unlike purposes. These differences, it was pointed out, made the two

[15] Letter, Commanding General, First Service Command, to Commanding Officers, All Posts and Camps, First Service Command, 10 Apr. 1944, subject: Reconditioning in General and Station Hospitals.

groups incompatible, and attempts to combine the reconditioning of the two classes would risk failure and lower the morale of both. Separate grouping and separate programs were indicated for the two classes.

Another principle was that the convalescent soldier should continue to be a patient, to receive continuing medical care, and an adjustment of his program best to meet his physical needs. This principle, too, was consistently maintained.

Ward officers in the convalescent hospital were imbued with a sense of their responsibility to their patients. Consultations were arranged with specialists when necessary. Regular medical rounds were made and the patient's progress noted. On this basis, physiotherapy, remedial exercises, gymnastics, and occupational therapy were individually prescribed.

The institution of the convalescent hospital at Camp Edwards permitted greater scope in the reconditioning program.

The surgical consultant believed that it would be desirable to develop a close liaison, on the one hand, between medical officers of hospitals and reconditioning units, and, on the other, between these medical officers and those officers empowered to make classification and assignment of the sick and wounded soldier following recovery. He believed that such assignment should take into account information gained by medical officers and that failure to do this would result in many improper assignments. Thus, more satisfactory classifying and assigning could be done, and the rehospitalization of many patients be avoided.

This matter of reclassification and assignment was made the subject of a memorandum to General Rankin. In it, Colonel Cutler stated that the collecting of data pertinent to subsequent classification should begin during hospitalization, and that information acquired concerning the soldier at the hospital where definitive treatment was given should accompany the soldier to the reconditioning unit. At the reconditioning unit, further data concerning his progress, physical status, response to training, and acquired abilities might be added. These data should be fully utilized, Colonel Cutler recommended, in effecting intelligent disposition, and specific recommendations as to the type of duty a soldier may be able effectively to perform should be furnished by his physicians to the authority performing classification and assignment. It was proposed that an officer authorized specifically to recommend such assignment to au- rities at the personnel distribution center be placed in each of the general and convalescent hospitals. At the reconditioning conference held at Thomas M. England General Hospital on 25 and 26 April 1944, it was proposed that reclassification officers be actually placed in various hospitals. Such reclassification officers were assigned in June 1945 to general hospitals.[16]

The surgical consultant also believed that adequate and accurate information should be furnished to the soldier concerning his physical status and the nature of serious disability he had suffered. It was represented that patients required such diagnoses and records for health guidance and for the

[16] War Department Circular No. 176, 13 June 1945.

information of their civilian physicians in the event of illness or of complications arising from the service illness or injury. Several instances were brought to the attention of the surgical consultant in which the lack of this information had worked to the disadvantage of discharged soldiers. The securing of such information by the veteran's civilian physician through channels might be attended by such delay as would render the information useless. Upon recommendation of the surgical consultant and under authority of Army Regulations No. 40–590, dated 29 August 1944, a command letter was issued on 9 April 1945 by Headquarters, First Service Command, calling the attention of commanding officers of posts, camps, and stations to the provisions of that regulation.

The letter stated: "It is desired that every soldier separated from the service in this Command be informed of his right to request a transcript of the medical record of any illness for which he may have been hospitalized while in military service. The importance of this record for his future protection and welfare should be explained to him. It is further desired that he be informed that the proper method of making this request is through channels to the Commanding Officer of the latest Regional, General, or Convalescent Hospital in which hospitalization occurred." The letter further directed that the furnishing of requested records be facilitated by the commanding officer of the hospital concerned and that commanding officers of personnel centers and hospitals provide for the inclusion of this information in orientation lectures given by separation counseling officers.

MEDICAL EDUCATION PROGRAM

One of Colonel Cutler's duties was to further education activities of the staffs of the various hospitals. He always inquired whether proper library facilities were available and attempted to determine whether there was an effective program of meetings and staff conferences. Such meetings and conferences were arranged and maintained in all hospitals during the consultant's tour of duty. It was the consultant's practice frequently to attend such meetings and to join in the discussion, occasionally presenting clinical material himself. In most of the hospitals of the command, he presented illustrated talks and demonstrations on the early care of hand injuries and other topics. It was his practice, also, to distribute and explain information gained at meetings of surgical societies and conferences held at the Office of the Surgeon General and in other commands. At all conferences attended outside the command, the consultant reported on results and procedures developed within the First Service Command. From time to time, selected officers were sent to visit hospitals in other commands in order to learn methods and procedures successfully developed there. By this means the First Service Command hospitals benefited by the experience of other facilities in such matters as the employment of penicillin and streptomycin, special methods in the care of paraplegics, and reconditioning.

A program which assigned a number of recently commissioned officers to hospitals for periods of about 6 weeks' duration provided another educational advantage. In the hospitals, programs of instruction for these men were conducted by the staff.

The consultants at First Service Command headquarters aided in the development and prosecution of the program of the New England Committee for War-Time Graduate Medical Meetings. Schedules were arranged for the visits of instructors furnished by the committee to all hospitals.

Clinical meetings at Lovell and Cushing General Hospitals were attended by medical officers of the First Service Command, Navy medical officers, and members of the civilian profession. At one meeting at Cushing on 16 April 1945, the Boston Orthopedic Society was the guest of the Cushing staff. The attendance exceeded two hundred. A combined medical exhibit was presented by Lovell and Cushing General Hospitals in conjunction with the Navy at the meeting of the Massachusetts Medical Society in Boston on 23 and 24 May 1944.

The visits of The Surgeon General and of his special consultants were of great value in maintaining high professional standards and in the interpretation of directives. The visits of the civilian consultants proved valuable. Among these visits were those of Dr. Smith-Petersen, Dr. Jason Mixter, Dr. Webster, Dr. Ivy, Dr. Frank R. Ober, Dr. Bunnell, and other distinguished members of the profession. Specialists in the New England area responded readily to many requests by the surgical consultant for assistance in the solution of specific clinical problems.

It was the consultant's policy to rotate officers from the smaller station hospitals and from the prison camps into the general hospitals for periods of duty, and many such transfers were made.

An effort was made to encourage the members of the surgical staffs to qualify for licensure by their specialty boards, and several officers received approval during this period. Papers and reports of clinical investigations prepared by the surgical consultant and by members of hospital staffs appeared in medical publications. In all matters pertaining to his duties, the surgical consultant was accorded the fullest assistance and cooperation by the service command surgeon, by all officers of the headquarters staff, and by the commanding officers of hospitals. The effort, interest, cooperation, and loyalty of the hospital surgical staffs left nothing to be desired.

CONCLUSIONS

The experiences of this author as the surgical consultant of the First Service Command have led to the following personal observations:

1. The value of the consultant system depends on an understanding by command authority of its proper function as an agency for attaining and maintaining the highest level of professional performance in the Armed Forces.

2. As far as is consistent with military action, consultants should be accorded the fullest freedom of movement within their respective areas. Orders for their movement should be determined in large measure by their own estimate of where their services will be most effective at any moment.

3. Free, direct communication should be permitted consultants with the professional personnel under their supervision through technical rather than command channels.

4. Grading and placement of officers in their specialties should be done, where practicable, with the consultants' knowledge and, as far as possible, according to their advice.

5. Degree of responsibility to be given an individual in the care of patients should be determined by professional competence rather than by military rank. As far as possible, rank among professional medical officers should be made consistent with competence and determined primarily on that basis.

6. Under the consultant's advice, utilization of pooled or casual medical officers should be facilitated by their temporary assignment to installations in areas where shortages of professional personnel exist.

7. Whenever practicable, medical officers stationed in small installations, especially in remote and isolated areas, should be rotated into the larger general hospitals for periods of duty. The consultants should assume responsibility for recommending such specific transfers to the command authority.

8. In future planning for fixed medical installations, adequate provision should be made for (1) central supply facilities, (2) braceshops, (3) recovery wards, (4) adequate operating rooms for accommodation of peakloads, and (5) air-conditioning of operating rooms.

9. Separate programs of reconditioning should be provided for convalescent soldiers who are to be returned to duty and for those who are to be separated from service.

10. Proper classification and assignment of soldiers returned to duty from hospitals requires close cooperation between the classification and assignment officers and the medical officers last concerned in the soldier's recovery from injury or illness.

11. For health guidance and for the information of any subsequently attending physician, a soldier discharged from a service hospital should be furnished a record of the diagnosis of his injury or illness and all pertinent data concerning it.

CHAPTER VIII

Second Service Command

Robert H. Kennedy, M.D.

EXPERIENCE AND ORIENTATION

Col. Robert H. Kennedy, MC, was Chief of Surgical Services at Percy Jones General Hospital, Battle Creek, Mich., from September 1942 to August 1944 and at Mayo General Hospital, Galesburg, Ill., from August 1944 to January 1945. Both hospitals were in the Sixth Service Command. During this period he also served on a number of occasions as acting surgical consultant to the Sixth Service Command headquarters, which had no consultants assigned to its medical division. This arrangement of combined duties as chief of surgical service and acting surgical consultant was unsatisfactory, yet it did give some orientation as to the possible problems and opportunities of a surgical consultant.

Colonel Kennedy was given no guidance as to his duties from the Office of the Surgeon General or the local command at the time of his assignment as surgical consultant, Second Service Command, on 18 January 1945. Neither was there any period of orientation. The value of his work, therefore, depended on the attitude of the service command surgeon toward administrative and professional problems. It was necessary that mutual confidence be developed first and that, once mutual confidence had been established, a continuous effort be made to keep the new consultant's work mainly on the professional rather than the administrative level. Colonel Kennedy was accorded full cooperation from the Office of the Surgeon General and the service command surgeon throughout his tour of duty, which ended 31 January 1946.

ADMINISTRATIVE DUTIES

There was a border zone between administrative and professional decisions and details in which a consultant was of much assistance to the service command surgeon, but as a rule the consultant employed his time to the greatest advantage in supervising patient care—indeed it was his primary responsibility to see that such supervision took precedence over his other duties. For example, each commanding officer in the Second Service Command submitted a monthly request for promotion. Also, each division in the service command headquarters was asked to rate monthly, in order, all officers on the roster with regard to priority for promotion. This entailed Colonel Kennedy's going over several hundred names in which scores of changes occurred each

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month. It was natural that few, if any, promotional vacancies should exist for the surgical staff each month. The time spent on trying to appraise these men, conscientiously in order to preserve morale, was largely wasted and would have been spent more wisely on clinical problems.

ADMINISTRATIVE FACTORS IN PROVIDING PATIENT CARE

Hospital Construction

The type of hospital construction made a great difference in the efficiency of administration and of professional care. There were five general hospitals in the Second Service Command. One, which was of the cantonment type, built after the war began, could be operated efficiently. Another, a considerable portion of which had been built before the war, consisted of two cantonment type units a mile and a half apart and could never be properly integrated. Two new State hospitals were taken over and ultimately functioned well, but only after numerous structural changes and adaptations. The changes were so extensive that the State could barely recognize these institutions when they were returned. The fifth general hospital was made up of several resort hotels in an area in which all hotels were not released to the Army. This setup was never satisfactory for effective administration and resulted in much wasted effort. Good patient care was rendered in all, but the consultant's time required at each institution was definitely proportional to the effectiveness of hospital construction.

Location of Hospital

The site of a hospital played a vital part in its efficiency. A hospital within New York City was over an hour's travel from the traditional centers of recreation in Manhattan. Patients could go to Manhattan rarely, but were always restless because of its proximity. Well-meaning lay persons came in hordes to try to help, and interfered considerably with orderly care. A hospital at a shore resort had good individual morale among patients, difficulties in maintaining discipline, and constant spoiling of troops from exposure to tourist crowds (fig. 29). A general hospital within a training post was unsatisfactory from a morale and recreation standpoint. The cantonment type of hospital 6 or 8 miles from a small inland city seemed to keep its patients uniformly satisfied and adjusted.

Personnel

The nonavailability of competent professional personnel throughout 1945 was a great problem. Bed occupancy in Zone of Interior installations was constantly increasing. The amount of required operating and rehabilitation was stepped up markedly. In each of the surgical services, there was a scarcity of experienced personnel except among a few top key men. By the fall of 1945, a steady stream of medical officers were returning through New York

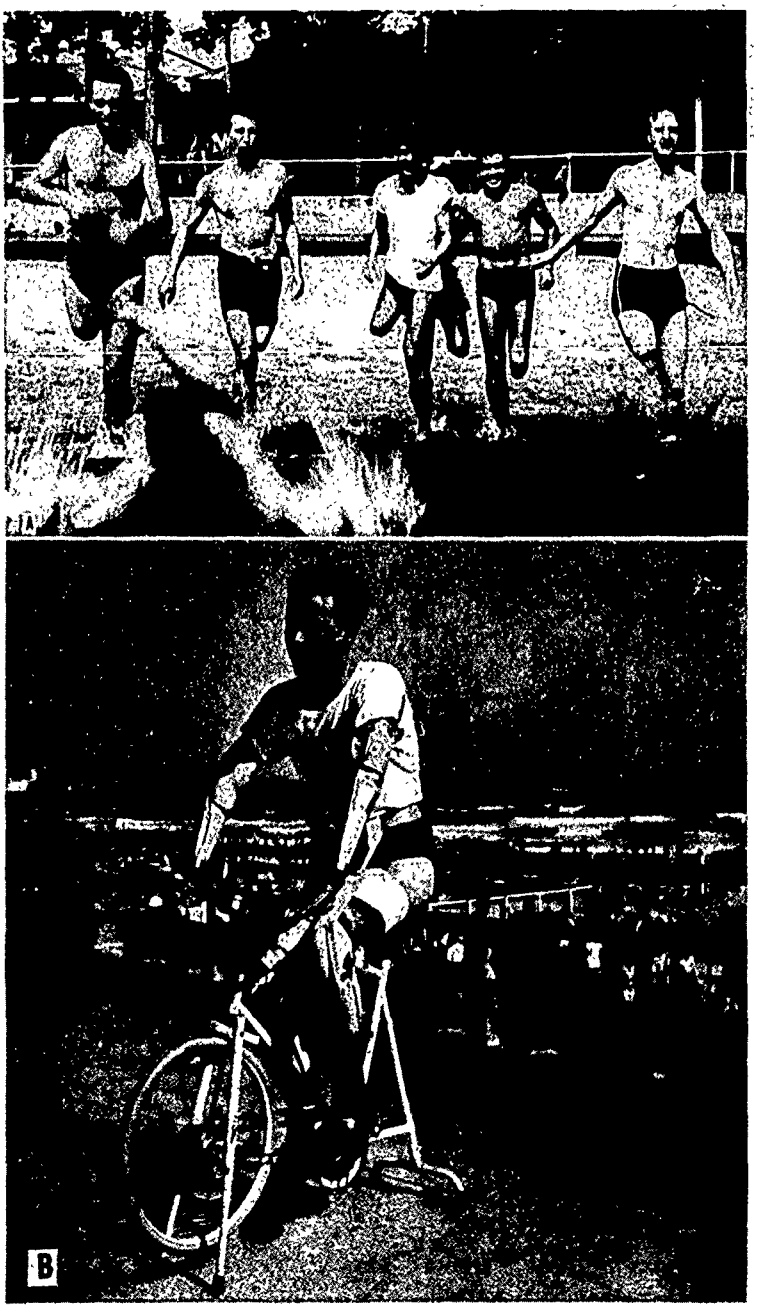


FIGURE 29.—Recreational and exercising facilities for amputees. A. Amputees swimming. B. Quadruple amputee riding exercising bicycle. Note tourists on open beach.

City from abroad and had to be assigned to posts according to their experience. The major interest of many of these officers was discharge. It was remarkable that the greatly increased volume of work was carried on so efficiently. Even at that late period in the war, the greatest lack was still in trained orthopedic surgeons.

The most efficient organization to head a surgical service proved to be that consisting of a chief, an assistant chief, and an administrative assistant to the chief. There was much paperwork to be done, and the chief should have been relieved of this as far as possible. The assistant chief, preferably, should have been a mature key man in one of the specialties, an officer who could have assumed the responsibilities of the chief in his absence but who otherwise had no office duties. The executive assistant to the chief should have been a young medical officer with an orderly mind, who probably was unavailable for oversea service, and who could have acted as a buffer for the chief. In the future, Medical Service Corps officers may be effective in this position, but not many members of the wartime Medical Administrative Corps were customarily ready for such a position.

The general hospitals varied so greatly in their construction, location, and special missions that a table of organization had little practical value. For example, officers at Halloran General Hospital, Willowbrook, Staten Island, N.Y., had to become debarkation officers about twice a week; those at Tilton General Hospital, Fort Dix, Wrightstown, N.J., were flooded with problems from the separation center after September 1945; and Thomas M. England General Hospital, Atlantic City, N.J., as an amputation and neurosurgical center, and Halloran General Hospital, as a neurosurgical center, required many more operating surgeons if the load was to be kept moving. The consultant had to jockey assignments constantly among hospitals according to the particular load and the available medical manpower.

PROFESSIONAL ACTIVITIES

Patient Service

In spite of all administrative problems, the basic job of the consultant was ward rounds. He learned how the chief of each section handled his patients and his professional personnel; who was happy and who, disgruntled; who was being used in a most effective spot, and who was not hospital material. Were patients being kept too long? Did they belong to a convalescent hospital? Had they reached maximal improvement? Would they be unfit for further military service, and should they be ready for their civilian life immediately without further rehabilitation? Were the men who constituted the disposition board taking all these factors into account? Clinical lectures might have been of value in slack times, but with the normal overload of duties during the author's service as a consultant, personal contact with the ward officer in examples of

his immediate problems was more important. Drs. William Darrach and William W. Plummer, as civilian consultants in orthopedic surgery, visited all the general and regional hospitals during Colonel Kennedy's tenure and were a constant source of stimulation to officers in group conferences. This left Colonel Kennedy free at the same time to delve into other hospital details.

CONFERENCES

A Second Service Command anesthesia conference was held on 17 June 1945 at Headquarters, Second Service Command, Governors Island, N.Y. It was attended by 74 persons, and it spread much valuable information. A conference on spinal cord injuries was held at Halloran General Hospital on 19 October and at Thomas M. England General Hospital on 20 October 1945 and was attended by 95 people. These sessions reviewed the most recent findings in the treatment of paraplegics.

Interhospital Visits

On several occasions there was sufficient lull in the load of work to permit the sending of the chief of surgical service at a general hospital to another general hospital in the command for from 2 to 4 days' observation. Similarly, the chiefs at the general and regional hospitals spent one day together at Camp Upton Convalescent Hospital, New York, N.Y. Several chiefs of sections were placed on temporary duty for short periods at hospitals outside the command for observation of particular types of treatment. All of these visits were vital in improving the care and lessening the morbidity of the individual soldier.

The consultant had an opportunity to visit a number of installations and facilities outside of the command. This was usually at the time of some special conference. In all instances, new valuable ideas were obtained from observing the manner in which problems were being met in other commands.

SURGERY IN GENERAL HOSPITALS

Amputation Center

The amputation center at Thomas M. England General Hospital was authorized to have 1,200 beds for amputees. In only 3 months was its census as low as 1,200; the maximum number of patients the hospital registered at one time was 1,625. Maj. Rufus H. Alldrege, MC, was Chief, Amputation Section, and did an outstanding piece of work. His results in Syme's amputations were particularly noteworthy.

In compression bandaging of the stumps, 2,000 to 2,200 Ace bandages had to be washed daily. Washing was being done in the hospital laundry, but the bandages were dried in open corridors in the basement, creating a most untidy appearance. What had been the hotel bakery adjoined the area and

was not in use at this time. It was found that the bandages could be spread out over the trays used for baking rolls and that each of the 8 trays of a single unit would accommodate between 20 and 40 bandages. Two motor driers with heating units were developed and the entire load of bandages could be dried in a total of 6 hours. Other problems were more difficult for solution.

The limb shop created many problems since as many as 292 prostheses were completed in one month. Personnel had to be changed too rapidly. Students always were in training. The limb shop personnel strength reached a high of 82. Individuals worked on day and night shifts. Research went on concomitantly with production, so that changes in material and types were too frequent. It would have been more efficient if research could have been carried on in a smaller unit and not where 1,500 amputees were waiting for their prostheses so that they could be discharged.

The work of the physical therapy personnel for the amputee was outstanding. Remedial gymnasiums with pulleys, steps, walking ramps, and mirrors were set up in two hotels. A new training program was set up late in 1945 according to which no soldier was allowed to wear his prosthesis until he had developed proper muscle balance of all parts of his body (fig. 30).

Striking work was done at Halloran General Hospital by combined neurosurgical and orthopedic operators in cases with healed wounds which required both a bone graft and peripheral nerve suture. The neurosurgeon exposed the involved nerves. With the aid of the neuropathologist doing frozen sections, the amount of necessary nerve was removed until there was no longer scar involvement. The orthopedist then entered the picture and was told by the neurosurgeon in upper arm cases how much shortening of bone was needed, if any, in order to bring the nerve ends together without tension. The orthopedist then prepared the bone ends and did his bone graft, and the neurosurgeon returned to the case and did the nerve suture and closed the wound. In some instances these procedures required as much as 12 or 14 hours, but in no instance was there severe shock. This shortening of bone, of course, was done only in upper extremity cases.

Neurosurgical Centers

In cases of herniated nucleus pulposus, if operation was indicated, the question of whether a fusion was to be done was decided by agreement of the neurosurgeon and the orthopedic surgeon.

The load of paraplegic patients at Thomas M. England General Hospital reached 110 and that at Halloran General Hospital, 108. Much thought and effort was exerted to obtain the best care for paraplegic patients. All fields of medicine concerned cooperated in the effort with a neurosurgeon in charge at Thomas M. England, and a urologist, at Halloran. At the latter hospital, large decubitus ulcers over the sacrum were closed after March 1945 by full

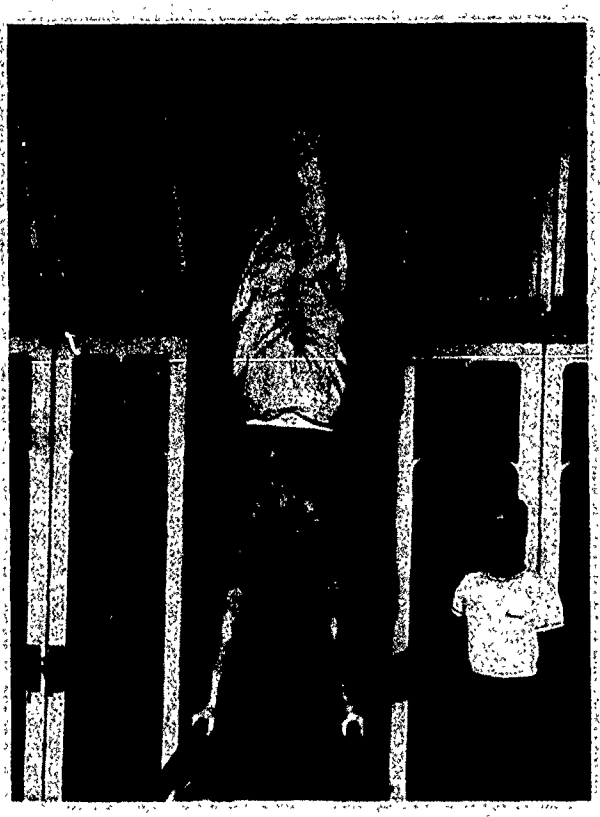


FIGURE 30.—Gymnastics in the reconditioning program at Thomas M. England General Hospital, Atlantic City, N.J.

thickness flaps mobilized by undercutting out over the buttocks, even approaching the great trochanters. It was often a 4- or 5-hour plastic procedure, but the results were excellent. The writer believes that Thomas M. England General Hospital was the first Army hospital to perform this operation. At this same hospital, a dining room was set up on the ward floor with tables so arranged that wheelchairs could be wheeled to the table with the patients' extended legs under the table. The dietitian was particularly valuable in the recovery of paraplegics. A printing press was obtained and a newspaper started. The paraplegics served as reporters, editors, typesetters, pressmen, and newsboys. One physical therapist was assigned full time to this ward, with a number of WAC personnel trained in physical therapy to assist her. At Halloran General Hospital, a large ward was set up as a gymnasium with mats, parallel bars, overhead ladders, wall ladders, and other similar equipment. An open-air swimming pool was completed in midsummer 1945 and was available to the paraplegics. The progress made in the professional and psychological care of these patients at both institutions was outstanding.

Orthopedic Sections

Thoroughly competent chiefs of the orthopedic section were present in all hospitals, but, except for the key men, the large load was under the direct care of men with too little experience or interest. The change in officers was so rapid that, in spite of much effort, the use of suspension-traction was never too satisfactory. Too many patients were kept in plaster encasement. The maintenance of proper length and axis while an open fracture was healing was accomplished particularly well at Halloran General Hospital as was also the conditioning of the quadriceps and the maintenance of proper power of the Achilles tendon. This was due to an exceptional section chief, Maj. George Carpenter, MC. At Thomas M. England Hospital, the amputation center made considerable fresh homologous bone available. Maj. Rafe N. Hatt, MC, chief of the orthopedic section, used this in many instances to replace loss of major bone length with excellent results. This was before the idea of a bone bank had been conceived.

In all but one hospital, the chief of orthopedic section was in charge of physical therapy. The least valuable physical therapy department was the one in which a full-time officer in physical therapy was in charge. In Halloran, the major portion of physical therapy treatment was performed on bed cases. This was as it should have been, rather than waiting for bed cases to become ambulatory. Massage should not have a major use in Army physical therapy.

The value of occupational therapy depended entirely on the imagination of the personnel. At that time, too few technicians were trained to give functional occupational therapy, and the stress was chiefly on recreational therapy. This was little needed outside of neuropsychiatric sections.

Miscellaneous Patient Care

The plastic, artificial-eye center at Halloran General Hospital, under Maj. Victor H. Dietz, DC, did beautiful work (fig. 31). Maj. Dietz was one of the originators of this process.

Anesthesia schools for nurses were conducted at four hospitals. Twenty-four nurses were graduated during 1945. The nurse anesthetists were of great assistance.

Cantonment type buildings lent themselves readily to the installation of a recovery ward adjacent to the operating suite. This was done at Rhoads General Hospital, Utica, N.Y., and at Tilton General Hospital. With a recovery ward, for which the anesthesia section was responsible, much better attention could be given to postoperative treatment as regards fluids, sedation, atelectasis, et cetera.

A central supply proved valuable in all hospitals. Because of the prevalence of hepatitis, a system was introduced at Rhoads General Hospital in the summer of 1945 by which all syringes and needles were carefully cleaned, then separately wrapped and autoclaved.



FIGURE 31.—Constructing and fitting artificial eyes at Halloran General Hospital, Staten Island, N.Y. A. Painting the iris. At far left is mold for preparation of the cornea, and the basic artificial globe is in the center. B. Affixing primary veins to the cornea. C. Patient wearing completed left eye.

SURGERY IN OTHER HOSPITALS

Station and Convalescent Hospitals

Twenty-eight visits were made to regional or station hospitals. The hospitals had many problems. In apportioning his time among these hospitals, the consultant took into consideration the greatest good for the greatest number.

The Camp Upton Convalescent Hospital required much time. Its census reached 4,100. Many patients were admitted directly from debarkation ports with no more than a field medical record. Many patients were sent from general hospitals to the reconditioning centers in braces and splints, at a time when directives were issued to clear general hospitals as much as possible. Orthopedic and neurosurgical consultants from Halloran General Hospital visited Camp Upton Convalescent Hospital weekly to advise as to care and disposition. Two fine remedial gymnasiums were opened in the fall of 1945 where patients were taken by companies for therapeutic exercise. It was a long hard pull for those concerned to succeed in their desires at this post. By January 1946, Colonel Kennedy believed that this hospital offered a tremendous opportunity for pretechnical and educational, as well as physical, reconditioning of the soldier under conditions in which his needed medical care was properly supervised and continued, and his disposition was determined after proper survey by competent officers.

Hospitals Not Under Jurisdiction of Second Service Command

There were within the Second Service Command area three AAF (Army Air Forces) hospitals and three port of embarkation hospitals, the latter being directly under the Chief of Transportation, Washington. The surgical consultant could visit the embarkation hospitals, according to regulations, only by the following chain of events: The request for consultation had to be initiated by the chief of surgery to the hospital commander, who, in turn, endorsed it to the commanding officer of the port of embarkation; the port commander then endorsed it to the Chief of Transportation; the request then went to The Surgeon General of the Army, to the Second Service Command Surgeon, and finally, to the consultant. Naturally, this process took several days and the soldier concerned was likely to be beyond the need of consultation. A similar chain of events was required in AAF hospitals. The situation was particularly unhappy because Camp Kilmer Station Hospital, Stelton, N.J., had a complement of 1,524, and the hospital at Camp Shanks, Orangeburg, N.Y., provided 1,259 beds. After the first visit of the consultant to each of these hospitals, the situation was corrected so that the chief of surgery telephoned his request directly to the consultant, who then made a visit to the hospital sub rosa. In the future, such situations should be corrected at a high level.

STREPTOMYCIN

Much of the early clinical work with streptomycin was carried out in the Second Service Command. In May 1945, a small quantity of this drug was obtained from Merck & Co. for use in bladder infections in paraplegics at Halloran General Hospital. In June, approval was obtained for a streptomycin pool in the Second Service Command, and 50,000,000 units were maintained at the Second Service Command Laboratory, New York, N.Y., and 10,000,000 units each were maintained at Thomas M. England, Halloran, Rhoads, and Tilton General Hospitals. The drug was to be issued only on authorization of the service command consultants after the case had been discussed with hospital personnel.

In several instances, streptomycin was used in acute abdominal emergencies, such as general peritonitis following ruptured appendix. Sometimes it was injected within a few hours of operation before cultures were obtained. In its use in infected bladders, it was found at Halloran that the *Proteus* bacillus could be promptly eliminated within 48 to 72 hours with a dosage of 1,200,000 units, but that the bacillus usually recurred within 5 or 7 days. When the administration was repeated, it was found that the bacteria were much more resistant to streptomycin. It was therefore determined that an initial dosage of from 2,500,000 to 3,000,000 units was necessary in these cases.

In August, the entire output of streptomycin was taken over by the Army and a certain amount of the drug was made available to Thomas M. England, Halloran, and Rhoads General Hospitals, which acted as pools for the rest of the command. During the last 3 months of 1945, streptomycin was used as little as possible because, due to the changeover of method of manufacture, little could be made available in comparison with the demands. In September 1945, under the direction of Capt. Edwin J. Pulaski, MC, a research project concerning the effect of streptomycin in war wounds was begun at Halloran. Certain ward beds were assigned to Captain Pulaski, and a special laboratory was set up.

SUMMARY

In the Zone of Interior, a consultant system was necessary in surgery. The consultant was able to diffuse knowledge at the various installations for the benefit of the soldier. He was able to assign surgical personnel so that they would be used at their greatest value. He was able to support professional personnel in positions involving responsibility often greater than that to which they had been accustomed. He was also the eyes and ears of the service command surgeon in the handling of the professional problems of the command. Close mutual understanding and cooperation between the surgeon and the surgical consultant were required, and when they were lacking a change in incumbents was indicated.

CHAPTER IX

Third Service Command

Walter D. Wise, M.D.

ASSIGNMENT, ORIENTATION, AND EARLY ACTIVITIES OF SURGICAL CONSULTANT

Lt. Col. (later Col.) Walter D. Wise, MC, was ordered to duty as surgical consultant to the Third Service Command and the Military District of Washington in August 1943. Previous to this time, he had been serving as medical director of Selective Service for the State of Maryland with the rank of lieutenant colonel. Rumor had had it that assignment as a surgical consultant carried with it the rank of colonel and that Colonel Wise would not be assigned to the area in which he lived. As noted, however, he was assigned to the mid-Atlantic area of the eastern seaboard, and his rank of lieutenant colonel remained unchanged until July 1944 when a promotion to the rank of colonel was received. Following this promotion, Colonel Wise was able to carry out his duties much more efficiently, to act with more authority, and to command the respect due a surgical consultant.

Since Colonel Wise was the fifth or sixth service command surgical consultant to be appointed, he profited considerably by the experiences of earlier appointees. For example, Col. Bradley L. Coley, MC, who was serving as surgical consultant to the Eighth Service Command, had presented before the American Surgical Association a paper dealing with the duties of a surgical consultant which proved to be a great help. Additional assistance was available through communication with many of the other consultants who were personal friends.

Owing to the fact that the commanding general of the Third Service Command did not know what functions the position of a surgical consultant entailed and had not been informed of Colonel Wise's appointment, the situation was at first embarrassing; and this consultant's duties were rather vague for the first few weeks. He visited the nearby smaller hospitals and made reports in an effort to learn the routine, to improve the surgical services in the various hospitals, and to become familiar with methods of preparing and submitting reports. Soon, orders were received to report to a general hospital in another service command for a month's indoctrination. In retrospect, it seemed that a trip of a few weeks or a month with one of the established surgical consultants would have been a better aid in the training of a newly

appointed consultant. Something was learned, however, about the paperwork in a general hospital, disposition boards, and, perhaps more important, about the weaknesses of some of the services in this particular hospital. After the month of training, Colonel Wise's routine work began with visits throughout the Third Service Command and the Military District of Washington which were continued until after V–J Day.

At the time of Colonel Wise's appointment there was as yet no medical or neuropsychiatric consultant in the Third Service Command, and no orthopedic consultant was ever assigned. The vast number of fractures and other orthopedic conditions were seen by Colonel Wise, who, fortunately, had had a large experience in fractures. The services of the late Dr. Guy Leadbetter of Washington, a civilian orthopedist and consultant to The Surgeon General, were available. Dr. Leadbetter visited a number of the general hospitals and some of the regional hospitals with the surgical consultant with great benefit to the patients, the orthopedists, and the surgical consultant. Eventually, the medical and neuropsychiatric consultants were appointed. The three consultants—surgical, medical, and neuropsychiatric—visited all of the medical installations in Pennsylvania, Maryland, Virginia, and the District of Columbia. They also met most of the ships coming in to Newport News, Va., with sick and wounded and accompanied the patients on the train to McGuire General Hospital, Richmond, Va., where they were sorted for distribution to appropriate centers (fig. 32). Before McGuire General Hospital was opened, some shipments of wounded went to Woodrow Wilson General Hospital, Staunton, Va.

OBSERVATIONS CONCERNING HOSPITALS

Personnel and Interpersonal Relations

By August 1943, the general hospitals in the Third Service Command were, with few exceptions, manned by well-selected, capable medical officers. The station hospitals, though the staffs were not permitted to do major-grade surgery except in emergencies, needed much more supervision and more frequent visits. The regional hospitals occupied an intermediate position in the type of surgery which was permitted and in the talents of the staffs. In correcting any inadequacies in the regional and station hospitals, Colonel Wise always had the full cooperation of the Office of the Surgeon General.

With one or two exceptions, there was little or no evidence of use of political influence in the hospitals of the Third Service Command. Friendships of long standing, however, or ties newly made among the medical officers of the Army of the United States and the U.S. Army created some tenseness and at times inefficiency. In one important hospital, there was a staff that contained several friends of civilian days, and there was a group from one large city who had worked together at home. Some of these had received assignments by the commanding officer of the hospital which were not strictly based on merit, with some bad results. The consultant was slowly learning



FIGURE 32.—McGuire General Hospital, Richmond, Va.

about this situation when the Office of the Surgeon General obtained accurate inside information and sent representatives from both the Surgical and Medical Consultants Divisions, and the situation was remedied.

A situation that seemed to the surgical consultant to need improvement was the occasional lack of ability on the part of the Regular Army medical officer to give proper value to the professional qualifications of an outstanding temporary medical officer commissioned in the AUS (Army of the United States). This resulted in some inequities not conducive to good service. Likewise, some of the highly trained surgeons of the AUS would not or could not assume administrative responsibilities demanded by the Army. It was in such situations that the consultant could be of great value. He, too, was of the AUS, however, and sometimes went down to defeat at the hands of an occasional hospital commander who had been trained to adhere to rigid requirements of the Regular Army.

Outstanding Performance of Personnel

Upon assuming duties as surgical consultant, Colonel Wise found that, as previously mentioned, there was already much surgical talent in the command, particularly in some regional hospitals and in the general hospitals. Some of this talent was, of course, ordered overseas; some remained for the duration; and some had already returned from overseas. Other talented surgeons came later. Not all who deserved commendation can be mentioned, and it may be wrong to name any for fear of unjust omissions. It would seem lacking in appreciation, however, not to mention the high type of work done by such men as James Barrett Brown and Bradford Cannon in plastic surgery; Rettig Arnold Griswold, John C. Lyons, John Owen, and Leslie E. Bovik in general surgery; T. Campbell Thompson, Henry F. Ullrich, George O. Eaton, Leonard B. Barnard, and Sims Norman in orthopedics; Brian B. Blades in chest surgery; and M. Elliott Randolph in ophthalmology. Each of these surgeons had associates of ability. Outstanding help was given the regional hospital at Fort George G. Meade, Md., by Lt. Col. John H. Mulholland, MC, of the 1st (Bellevue Affiliated Unit) General Hospital.

Equipment

The hospitals were superbly equipped with instruments, traction apparatus on the wards, X-ray machines, and physiotherapy equipment. When Germany was defeated and the end of the war seemed in sight, many temporary wartime medical officers gave consideration to this plethora of Army hospital equipment and the dearth of it in civilian hospitals. Remembering that this valuable material had already been paid for by the public, they wondered if it could not be made available at reasonable rates to the civilian hospitals at the close of the war. Suggestions along these lines were made

well in advance of V–J Day, and hopes were high, but realization fell far below hopes.

Effects of Rapid Demobilization

After V–J Day, rapid demobilization so damaged medical organizations as to make it difficult to keep the Zone of Interior hospitals manned with capable surgeons. The consultant had little or no time for supervision of the deteriorating surgical work because he was kept at service command headquarters trying to find replacements for officers being let out. Unfortunately, the discharge of patients from hospitals could not keep pace with the discharge of medical officers. The signing of the armistice stopped surgical admissions to a tremendous degree, but it did not speed up the healing of the cases of osteomyelitis of the femur nor did it provide the needed plastic surgery in those previously wounded or burned.

SUMMARY OF ACTIVITIES

There were many incidents outside of the routine duties of the consultant which served to keep up his interest and to be stimulating. Among these was the recognition of the dangers of Pentothal sodium (thiopental sodium) as an anesthetic agent and a report of these findings to the Office of the Surgeon General, with the resulting directive from that Office as to the proper use of the drug. Another was attendance at a very secret conference dealing with Japanese balloons which were being sent on the stratospheric air currents and which had landed in considerable numbers in the Northwest and also in the north-central region of the United States. There were many other experiences which were more of personal than of historical interest.

The duties of the service command consulting surgeon in essence were to obtain the best treatment for ill or injured members of the Armed Forces and any others treated in service command facilities. To this end, he evaluated surgical personnel and equipment of all kinds; consulted about individual patients, classes of patients, new and old measures and procedures; and attempted to be an activator of hospital staffs. He stimulated staff meetings, grand ward rounds, conferences, and journal clubs; helped arrange for speakers; and tried to see that new procedures of merit were not neglected, while trying to discourage procedures that had been tried and found wanting or did not justify further trial. In this he was aided a great deal by formal meetings and discussions at installations within his service command and by many meetings arranged by the Office of the Surgeon General and held in Washington or commands within reasonable distances.

COMMENT

The sudden expansion of the Army Medical Corps and the rapid establishment of the many oversea and Zone of Interior hospitals and other medical units was necessarily a great drain on medical and surgical talent. As a re-

sult, all demands could not be met in the way desired. This naturally led to much effort in the attempt to get the most advantageous disposition of available men. These efforts, in turn, were accompanied by disappointments here and criticisms there. Though the ideal could not be reached, nevertheless the surgical service received by the patients was, all things considered, of a high order.

CHAPTER X

Fourth Service Command

Mather Cleveland, M.D., and James J. Callahan, M.D.

Section I. September 1943 to April 1944

The Fourth Service Command, comprising the southeastern tier of States—North and South Carolina, Georgia, Florida, Tennessee, Mississippi, and Alabama—during 1943 and 1944 had approximately 2 million troops in training. To serve the medical needs of these troops, there were 130 station and 11 general hospitals.

The Fourth Service Command surgeon, Col. Sanford W. French, MC, with headquarters in Atlanta, Ga., had the services of consultants in medicine, surgery, and psychiatry, and in September of 1943 a consultant in orthopedic surgery, Lt. Col. (later Col.) Mather Cleveland, MC, was added. At the time, only one other service command (the Fifth) had an orthopedic consultant.

The training of troops, ground or air, entailed strenuous physical exercise with many fractures. The sports program probably contributed as many fractures as, if not more than, the obstacle courses. Accidents due to vehicles on and off the post added to this list of injuries to bones and joints. A large percentage of the surgical cases in all hospitals were injuries of this type and were under the care of the orthopedist. Even before casualties began to arrive from overseas, it was obvious that an orthopedic consultant was required for the large service commands.

Colonel Cleveland's tour of duty in the Fourth Service Command as orthopedic consultant extended from September 1943 to mid-April 1944. During this period, the general hospitals were being increased in number and the large station hospital staffs were being depleted to supply medical personnel for oversea units. In many instances, adequately trained orthopedic surgeons were no longer available in station hospitals. Elective surgical procedures and major fractures, by directive, were supposed to be evacuated to general hospitals, and orthopedic surgery in station hospitals was confined to first aid, minor fractures, and an enormous outpatient service.

HOSPITALS

Many of the station hospitals in the Fourth Service Command were very small, especially those serving a great majority of the smaller airfields. For instance, within a radius of 50 miles about Finney General Hospital, Thomas-

ville, Ga., there were 5 or 6 small Air Force station hospitals, each completely equipped and staffed with an average number of nurses and medical officers for the patient load. There were also large Air Force station hospitals, such as those at Keesler Field, Biloxi, Miss., at Gulfport Army Air Field, Gulfport, Miss., and at Maxwell Field, Montgomery, Ala. These were very well provided with nurses and competent professional personnel and rendered a high quality of professional care.

The station hospitals of the Army Service Forces serving large numbers of troops of Army Ground Forces at the larger training centers, such as Fort Bragg, N.C., Fort Jackson, S.C., Fort Benning, Ga., Camp Blanding, Fla., Camp Van Dorn, Miss., and Camp Shelby, Miss., were enormous and, in the light of experience, were vastly overbuilt and, in time, professionally undermanned. Four of these hospitals had 4,000 or more beds, and the maximum census, the writer believes, was never over 50 percent of the bed capacity.

The general hospitals in the service command were almost invariably well equipped and had a competent professional staff in each instance.

Although the semiautonomous Army Air Forces were actually under Army command, it became increasingly evident, during the consultant's tour of duty, that the service command consultants were less and less welcome at the Air Force hospitals. It was impossible not to call attention to the evident fact that the small Air Force station hospitals were too numerous and too overstaffed with nurses and physicians, while many of the hospitals serving the Army Ground Forces were lacking sufficient nurses and physicians for the patient load. These personnel discrepancies constantly called to one's attention became distasteful, and the service command consultants finally visited Air Force hospitals only on invitation. It is to be hoped that in any future emergency, there will be better distribution of physicians and nurses.

PROFESSIONAL PROBLEMS AND ACTIVITIES OF THE CONSULTANT

The problems confronting a service command consultant in orthopedic surgery were mainly (1) personnel and (2) professional care of soldiers with injuries involving bones and joints. The field of military orthopedic surgery was well defined and well recognized in most instances. An occasional chief of surgical service considered himself competent to handle the entire field of surgery and overrode the judgment and neglected to use the operative skill of his orthopedic chief. This resulted, in one instance at least, in ill-advised elective knee joint surgery.

The problem of having skilled personnel in the proper places was fairly constant. There were increasing inroads on the orthopedic services of the various large station hospitals as personnel were withdrawn to staff new hospitals intended for oversea service. Withdrawn also were orthopedic surgeons belonging to affiliated hospital units, which had completed their parallel train-

ing with the station hospitals and moved to ports of embarkation. It became evident that most of the station hospitals would no longer have trained orthopedic surgeons to do a definitive type of surgery.

By the spring of 1943, directives had been issued to transfer all major orthopedic problems, including elective surgery, to the general hospitals of the command. The 2 original general hospitals in the command were increased, during late 1943 and early 1944, to 11, and an adequate orthopedic section was provided for each of these hospitals. In some instances, well-trained orthopedic surgeons were left in some of the larger station hospitals, but the scope of their professional work was curtailed. For the most part, the directives were complied with, and major orthopedic problems were handled in the general hospitals.

During the author's 7 months as orthopedic consultant for the Fourth Service Command, he visited the 11 general hospitals, all of the large Army station hospitals, and many of the smaller ones, approximately 60 hospitals in all.

A separate report was rendered on each hospital. Reports on class I hospitals at posts, camps, and stations were submitted to the Commanding General, Fourth Service Command, through the commanding general or officer of the installation. If the hospital was located on an installation of the Army Air Forces, the report was submitted to the commanding general or officer of the airbase. Reports on general hospitals surveyed were submitted to the Commanding General, Fourth Service Command, attention Chief, Medical Branch.

These reports were thorough. All orthopedic patients were seen and problems were discussed fully with the chief of section. The X-ray department, physical therapy, rehabilitation, and disposition of patients were reviewed. The operating rooms were inspected, and anesthesia, nursing, and personnel were commented upon. A hospital with a large orthopedic service or section might take 2 or 3 days to survey. At the end of such a survey, very complete data were available on which to evaluate the orthopedic care afforded in that particular hospital or medical installation.

Colonel Cleveland considered his chief function to be teaching and the interpretation of the various directives related to medical care. The term "inspection" seemed to connote a snooping and, perhaps, an effort to find fault. A consultant had to be fair and kindly, but he could not escape occasionally finding conditions which required warning or even reprimand through proper channels. The consultant needed to "walk softly but carry a big stick." He could only advise; the command surgeon could implement the advice if he saw fit. A consultant who hoped to be invariably popular was, above all, foolish.

Personnel allotments for a service command headquarters carried no specified position or rank for medical consultants. It was Colonel Cleveland's considered opinion that, since the Armed Forces are constructed on a basis of rank and are thoroughly rank conscious, consultants should have had rank

equal to or higher than that of the commanding officers of all medical facilities they were called upon to visit.

Occasionally, the consultants of the Fourth Service Command were sent out as a team to survey a trouble spot for the service command surgeon. In one instance, one of this service command's newly opened general hospitals received undue and unwarranted publicity by a radio commentator because of the confusion that attends any new staff which is overwhelmed by the arrival of a large number of patients. A complete survey of the hospital was made, all patients were seen, and some semblance of order was instituted. Additional orthopedic personnel were provided. Many of the patients admitted to this hospital could have been disposed of at the station hospitals, a majority by return to duty.

On another occasion, all the consultants were sent together to Stark General Hospital, Charleston, S.C., to see the first casualties returned from North Africa. The wounds of the extremities with long-bone fractures had at this time all been treated by the closed-plaster technique—a method later abandoned. Many of the amputees had protruding bone ends visible in the stump due to failure to utilize skin traction on the stump. Stark General Hospital was transformed into a debarkation hospital and the casualties were shipped from this point to the general hospitals nearest the homes of the returnees.

The relationship between the four consultants—medical, surgical, orthopedic, and psychiatric—in the command surgeon's office was cordial and helpful. Mutual problems were freely and fully discussed. The surgical consultant and orthopedic consultant frequently, on separate tours or consultations, noted and brought to each other's attention problems affecting the surgical service or the orthopedic section of various hospitals.

It was a pleasure to serve under Colonel French and on his staff with Col. I. Mims Gage, MC, Col. F. Dennette Adams, MC, and Col. (later Brig. Gen.) William C. Menninger, MC. The staff made a constant effort to see that the sick and wounded of the Fourth Service Command received superior care. It was believed that, on the whole, they did receive such care.

MATHER CLEVELAND, M.D.

Section II. 1944 and 1945

GENERAL DUTIES OF THE CONSULTANT

The consultant's general duties were twofold as follows: (1) To supervise the overall professional care of the sick in hospitals of the Army Service Forces in the service command, and (2) to evaluate professional personnel and make recommendations for their assignment. In further detail, the orthopedic consultant, Lt. Col. James J. Callahan, MC, provided overall direction and supervision of the orthopedic services in each medical treatment facility, conducted regular rounds of orthopedic wards, maintained liaison with the Professional

Service in the Office of the Surgeon General and the other members of the service command medical section, evaluated professional personnel assigned to orthopedic services within the service command, and made recommendations regarding assignment and transfer of personnel. Professional papers were submitted to the consultant for his approval for publication by the Medical Department. After reviewing these papers, he forwarded them to the Office of the Surgeon General. It was the consultant's purpose to encourage by precept the highest level of professional care of patients and the general improvement, with respect to professional information and skill, of the officers assigned to the orthopedic services. He had to be available for professional consultation concerning orthopedic cases. It was expected of the orthopedic consultant that he make suggestions for the correction of deficiencies in service.

It may go into the record that, in Colonel Callahan's personal experience as an orthopedic consultant, he always received the fullest cooperation of the service command surgeon, who was, first, Col. Sanford W. French, MC, and, later, Brig. Gen. Robert C. McDonald. Both officers always gave a sympathetic ear to suggestions. Most observations were discussed with the commanding officer and chief of services at each hospital, and corrections or suggestions were made at the time of discussion. The commanding officer and the several chiefs of services in every instance gave the most constructive cooperation.

Area Served

The orthopedic consultant served as adviser to the service command surgeon and, through him, advised the appropriate branch in the Office of the Surgeon General. The services of the orthopedic consultant of the Fourth Service Command were available to the 40 hospitals in operation at the close of 1944 in that command. Ten were general hospitals, of which three—Kennedy, at Memphis, Tenn., Lawson, at Atlanta, Ga., and Northington, at Tuscaloosa, Ala.—were designated as special centers for neurosurgery as well as orthopedic surgery. Lawson General Hospital was, in addition, an amputation center; and Northington General Hospital was also a plastic center where specialists performed plastic surgery. A creditable achievement may be recorded here because of the many corrections of deformities and disfigurements which enabled restored patients to be returned to society and even to duty.

The Fourth Service Command did not have its own vascular center; thus, all vascular surgery cases had to be transferred out of that command.

The remaining seven general hospitals were Battey, at Rome, Ga.; Finney; Foster, at Jackson, Miss.; Moore, at Swannanoa, N.C.; Oliver, at Augusta, Ga.; Stark; and Thayer, at Nashville, Tenn. All the general hospitals had qualified orthopedic surgeons who were certified by the American Board of Orthopedic Surgery.

Stark General Hospital was the receiving hospital for the Fourth Service Command. There, patients were received from overseas; casts were changed or removed; wounds, dressed; new casts, applied; and the patients were made

generally comfortable before they were transferred for definitive treatment to hospitals close to their homes. The staff at Stark General Hospital did a superior service under pressing circumstances of great numbers of patients passing through in rapid turnover.

PROGRAM OF SPECIFIC DUTIES, 1944

During 1944, the orthopedic consultant visited each medical treatment facility in the Fourth Service Command at least once and in most instances twice. During these visits, ward rounds were made with the chiefs of the various services. The work of the several sections was reviewed, the quality of clinical records was assessed, and patients presenting special problems were examined on a consultative basis. The consultant was also called on to discuss current medical problems with the officers. Those consultations and general open forums contributed importantly to professional progress, for each of the officers had an opportunity to voice his opinion and to acquire knowledge from the other officers or the visiting consultants. This approach helped to unify the system of treatment, so that medical care to the patient was inevitably improved.

A further duty of the consultant was to attend meetings of the different medical disposition boards in order to facilitate the disposition of cases and at the same time to insure that disposition was made in accordance with existing instructions of the War Department.

It was required of the consultant that he supervise decisions to operate so as to eliminate unnecessary operations in cases in which disability existed before induction. It was in this regard, for instance, that recurrent dislocations of the shoulder and recurrent injuries or dislocations of semilunar cartilages—particularly in those cases in which there was a severe atrophy revealing a long history of injury—were accurately screened before surgery was permitted. It was evident in this type of condition that the patient would not return to active duty. Limitations were never imposed on any type of reconstructive surgery that might yield the best possible functional result. Treatment, however, had to be planned with a view to the patient's ability to return to duty whenever this was at all a possibility.

THE ORTHOPEDIC SERVICE AND SOME ASPECTS OF THERAPY

Back wards.—Some of the general hospitals had organized back wards (wards for back disorders) collectively controlled by the orthopedic surgeon, the neurosurgeon, the physiotherapist, and the roentgenologist. When the many cases in these wards had been reviewed, it was decided to have a consultation with all the ward personnel. Each case was again reviewed and examined individually. At the conclusion of the examination of all the patients, it was decided that a back ward was not a wise method of grouping back cases. The patients discussed their symptoms with one another and found them

similar, although the findings were often different; thus, subjective symptoms increased. The back wards were as a consequence disbanded. Disbanding these wards did not eliminate the problem, however, because so many cases had been diagnosed as disk syndromes or as positive for a disk finding. The disk had become a too popular diagnosis. Certainly, disk cases occurred, but not so commonly as the diagnoses had been made; moreover, it was believed that when they did exist, treatment should be conservative. Patients were thereafter placed in traction. Many were placed in plaster of paris casts. Many others were manipulated either with or without a cast application. The number of operative disks was substantially reduced. On the other hand, when there were definite indications for surgery—that is, when the patient did not respond to conservative care—the orthopedic surgeon assisted the neurosurgeon. If congenital deformities existed in the vertebras or if there were beginning arthritic changes, then stabilization, either with cortical and cancellous bone or cortical bone alone, enabled the patient to have restored to him a stable back. Those patients who had fusions performed were in a large measure relieved of pain; but those who did not have a fusion done frequently complained of the same pain postoperatively. Even though the patients thus operated on would usually have to be discharged because of disability, an effort was made to restore them so that they could return to gainful employment.

Physical therapy under orthopedic service.—The Surgeon General placed physical therapy under the orthopedic service, which was an excellent idea inasmuch as the orthopedic service furnished most of the patients for the physical therapy unit. The close cooperation between the chief of physical therapy and the chief of orthopedics in a hospital meant better and quicker rehabilitation of the patient. More than half of the patients in most of the hospitals were under orthopedic care. For that reason, it was suggested that the chief of physical therapy make rounds with the orthopedic ward surgeon to permit frank discussions in evaluation and choice of treatment.

Complete rounds innovation.—In point of fact, a logical suggestion was adopted pertaining to complete rounds. Each time the consultant visited a hospital, he saw every patient in the ward. This encouraged the younger officers, improved the morale of the patient who then felt that he was given the benefit of consultation, as he was, and confirmed each chief of service in his judgments or helped him to resolve his doubts in difficult cases.

Amputations and rehabilitation.—Lt. Col. Edward C. Holscher, MC, who was in charge of the orthopedic and amputation service at Lawson General Hospital, guided commendably the program instituted at the hospital in which, for example, every effort was made to preserve the involved joint, which was usually the knee joint. Conservative treatment, to be sure, as always, depended on careful evaluation so that the patient's life would not be endangered. Efficient traction, careful plastic repair, early physical therapy, and rehabilitation in all its facets all constituted care of such superior quality that many of the amputees could be reclassified and returned to duty.

The formation of a large rehabilitation center at Daytona Beach, Fla., called the Welch Convalescent Center, significantly relieved that phase of the workload at the general hospitals. As soon as a patient was ambulatory, he was transferred to that large installation where care was geared exclusively to the problems of rehabilitation. There, the will to get well was an active force. Under the direction of Maj. Newton C. McCollough, MC, the section on orthopedics provided superior care. As the service command consultant on an inspection visit, Colonel Callahan had the opportunity to examine every patient. Major McCollough and the consultant discussed individual problem cases to determine appropriate disposition regarding transfer to a general hospital or a specialty center for definitive care or for further surgery.

Prevention of fractures by proper fitting of boots and socks.—A program was developed at Fort Benning to correct avoidable deficiencies in the wearing of boots and socks. First to be considered were the shoes and socks of the parachutists of the airborne divisions. Each soldier was measured for correct size of socks and boots. Many had been wearing socks that were too short and boots that were inadequate. This malpractice was evidenced by the number of needless injuries to feet and the number of fractures of the leg and ankle. The boots were designed with double straps which would not remain in the slot intended for them; frequently the straps would catch in the shroud of the parachute, throwing the foot. As a result, typical fractures of parachute jumpers were observed—fractures of the ankle and of the head of the fibula, as well as knee joint injuries. That defect in the boots was corrected.

It was Maj. Roy Ciccone, MC, who classified the fractures incurred and collaborated in bringing about the needed corrections in apparel.

Multiple operations of the knee.—At the beginning of the war, many operations of the knee were performed without enabling the soldier to return to duty. Instead, certificates of disability for discharge had to be issued. Later, a program was instituted whereby the men were better screened in the first place. Those operated on were given appropriate preoperative and postoperative exercise and rehabilitation opportunities; thus, the numbers that had to be discharged were greatly reduced. This curtailment of surgery did not apply to those who had received injury in line of duty, although the new exercise and rehabilitation measures, under complete supervision, benefited them as well.

Many of the cases of internal derangement of operative knees had been the result of insufficient care in evaluation before operation. There were, for example, two cases of arthrotomies in which no pathologic condition had been observed. An occasional soldier had been operated on for an internal derangement of the knee, although the condition had existed before induction. Inasmuch as half the orthopedic surgery at Fort Benning at one point concerned internal derangement of the knee, the opinion was submitted that each case be more carefully considered and evaluated. It had been true, moreover,

that soldiers who were operated on for internal derangements of the knee were allowed out of bed in less than a week after the operation. Rehabilitation was retarded and not hastened by such early weight bearing. Many distended, swollen, painful knees were observed as a result of too early weight bearing and early ambulation.

Recurrent dislocations of the shoulder.—Again, many cases of recurrent dislocations of the shoulder had existed before entrance or induction into the service. With the rigors of military training, dislocations were bound to recur. Early operations to correct these conditions had not been successful, so that the soldiers had to be reclassified for limited service or discharged. As time and experience progressed, it was realized that it took at least 6 to 12 months before such patients could be returned to useful service. The number of operations thereafter authorized was greatly reduced. Surgical correction was attempted only when the prognosis gave reasonable justification.

Fusion operations on the spine.—Fusion operations on the spine were authorized only when there was an unequivocal indication for the procedure. Backaches from conditions that had existed before induction into the service were rarely considered an adequate indication for surgery.

March fractures.—Another change that was instituted concerned fractures incurred during marches, designated march fractures. It was concluded that it was better not to transfer patients with march fractures to general hospitals because, by the time the diagnosis was made, the fracture was well on its way to healing. Two or three weeks of rehabilitation or of limited duty would enable the soldier to resume active duty.

Traction for simple fractures of the femur.—In the treatment of fractures of the femur, an order had been issued to place the extremity with simple small fractures of the femur in traction. That was wise, for the alternative measure of placing the leg in plaster—although it afforded good immobilization—did not give an opportunity to examine the limb for the presence of thrombophlebitis or phlebothrombosis. Neither did the plaster-encased leg permit early active physical therapy, including massage, muscle contraction, and movement of the knee and ankle—an essential motion. These difficulties, for example, were characteristically observed in fractured femurs evacuated from overseas in plaster spicas.

Many orthopedic surgeons were under the impression that casts represented the optimum in treatment, so that it was necessary in making rounds or visits to the hospitals to explain the advantages of the traction and to insist that the order be executed. Deformities had frequently been found in those cases in which the fracture had been immobilized in a body cast. Traction, either skin or skeletal, resulted in fewer deformities and fewer cases of shortening; moreover, it facilitated the dressing and care of wounds.

Open fractures and skin grafts.—There were many cases of open fractures of the shaft of the femur or of the tibia with a loss of bone substance in which skin grafts had been performed, a skin dressing had been applied, and

the leg had healed. Exercise had been ordered to keep the adjoining joints active so as to increase circulation and restore muscle tone. Later reconstructive surgery reinforced the shallow or narrow bone and resulted in excellent weight-bearing surfaces. This treatment certainly obviated the need for many amputations and prevented permanent disabilities in the weight-bearing extremity. The policy of saving what tissues remained so that something could be added to the preserved member was worthwhile as it gave a well-functioning limb as an end result.

Osteomyelitis and skin grafts.—Chronic osteomyelitis following open wounds was observed often, because of the program of treatment of open or compound wounds. At first the cases were protracted, but later, after the wound had healed or at least had begun to granulate, either early grafting was done or a skin dressing was applied. Because of the early skin dressing, the wound remained clean. Operation was performed early in such cases with a full thickness graft or pedicle graft. The entire program was well worth the time and effort as it reduced the morbidity and saved many an arm or leg that might otherwise have been lost.

To be sure, it was discovered early that the antibiotics were helpful, but they were not wholly responsible for the improved results. Antibiotics could not substitute for good debridement, skin coverage, or dressing in cases of chronic osteomyelitis or cases of large open wounds.

Massive bone grafts.—If the skin graft had fulfilled its purpose of a closed clean wound, then the consideration for definitive treatment was in order. Thus it was that large defects were soon closed with bone grafts. Many were successfully accomplished because of the clean wound and bed furnished by the skin graft; otherwise, in cases of large defects, it would have been necessary to amputate. In many instances, this important procedure prevented regrafting and the unnecessary loss of precious bone. Dr. John Flanagan at Kennedy General Hospital was responsible for some of the excellent surgery of these massive bone grafts which saved many arms and legs.

Regrettably, a bone bank was not available at that time. Bone from such a bank could have bridged the defect without sacrificing the patient's own bone and would have permitted the patient to be ambulatory early, without the risk of fracturing the good member at the donor site.

Hand surgery.—Hand surgery centers were established with the initial instruction given by Dr. Sterling Bunnell to all the officers from the general and regional hospitals. The benefits of this experience in how to salvage as many hands and fingers as possible and in making tendon and nerve grafts carried over into civilian life. Many hands which would otherwise have been useless were saved and rehabilitated. That effort represented the first time that emphasis was placed on the specialty of hand surgery.

The braceshop.—An important facet of the orthopedic organization was the braceshop. Most of the braceshops were in charge of civilian bracemakers who worked commendably for long hours in the performance of their duties and

in instructing Army personnel. Their trainees were able to produce professional braces and calipers. Many of the military trainees have carried the skill of bracemaking over into civilian life from the Army where they had performed so essentially in an auxiliary service vital to successful orthopedics.

Miscellaneous observations.—It was interesting to observe in the orthopedic clinics how many soldiers had objective symptoms, how many subjective, and how many had symptoms entirely without foundation. Of all symptoms recorded in the clinics, foot disorders represented about 70 percent; knee disabilities, about 15 percent; and backaches, from 15 to 20 percent. These proportions varied, to be sure, particularly in regional hospitals with large numbers of trainees. At Moore General Hospital, at one time, there were 40 cases of self-inflicted gunshot wounds.

It was interesting that there were so few cases of thrombophlebitis or phlebothrombosis among the vast number of injuries treated in the Fourth Service Command.

At Lawson General Hospital, there were four cases of temporary paralysis as the result of using the pneumatic tourniquet—three in the lower extremity and one in the upper. All patients recovered.

The large prisoner-of-war camp at Camp Forrest, Tenn., presented many serious orthopedic problems. Lt. Col. Clarence W. Hullinger, MC, was in charge, with the assistance of Maj. Ernest Dehne, MC, and other surgeons. Their program was notably efficient. Col. Mims Gage, the service command surgical consultant, and the orthopedic consultant frequently visited Camp Forrest for review purposes and, on occasion, participated in surgical procedures to rehabilitate patients. Colonel Gage's advice and constant vigilance for complications were noteworthy. The close cooperation between the surgical service and the orthopedic service was largely due to his interest.

All the commanding officers and personnel of the hospitals in the Fourth Service Command performed excellently during the writer's term as consultant. It was the exercised aim of all to give each injured serviceman the best possible result in the shortest possible time. To further that end, the best available professional personnel were invariably assigned to the positions of chiefs of services. As a consequence, during his tenure Colonel Callahan enjoyed the fullest cooperation of certain chiefs of orthopedic surgery who have not been credited in previous reports, such as Lt. Col. T. Campbell Thompson, MC, Lt. Col. Frank G. Murphy, Lt Col. Everett I. Bugg, Jr., MC, Dr. I. William Macklis, Lt. Col. Saul Ritchie, MC, Lt. Col. Edward Parnall, MC, Lt. Col. Harold C. McDowell, MC, and Maj. F. Bert Brown, MC.

JAMES J. CALLAHAN, M.D.

CHAPTER XI

Fifth Service Command

Claude S. Beck, M.D.[1]

ADJUSTMENT TO THE ARMY AND INDOCTRINATION

Realizing that the war was for a great cause, Lt. Col. (later Col.) Claude S. Beck, MC, was one of the many who felt that this country had obligations to help preserve democracy. Colonel Beck was eager to give up his work, important as he thought it was, and join the service. The uniform gave him a sense of satisfaction, but as an Army officer Colonel Beck was green as grass. A pool for medical officers was a new expression for him. A number of old friends and acquaintances were in it, and their common cause brought them all closer together.

The famous Walter Reed Army Hospital, where Colonel Beck first reported, emanated respectability; she was the queen bee of the Army and nothing less than the Office of the Surgeon General decided upon her medical personnel. The best of the Army Medical Corps were there. Colonel Beck listened to many unimportant lectures in his indoctrination and was given time to unwind from civilian life. He had a sense of guilt because he was not busy; then he wrote two medical papers. Soon afterward, he was assigned.

On the first day of his new assignment, Colonel Beck invited the service command (then corps area) surgeon to have dinner with him. He was anxious to find out about his duties without wasting time. Colonel Beck was informed that the surgeon would wait to see how they were going to get along before he accepted the invitation. Colonel Beck was still green and did not know how his own transplantation into the Army was going to turn out. Many others felt the same way, and these adjustments created problems which had to be met and solved. They were problems of uprooting and adjustment to a new environment. Every soldier had problems, and many of them Colonel Beck was to see in the Army camps later on. It took time and adjustment to become a soldier. This was a lesson everyone had to learn.

THE CONSULTANT SYSTEM

It appeared to Colonel Beck that the consultant system was new in the Army, although there had been consultants in World War I. At the begin-

[1] This account was written 10 years after the termination of the war. It was written by request, and I believed there was little I could add to the reports and recommendations made during the period of my assignment. It was also written from memory, because I did not have ready access to these reports. I assumed that my general impressions were desired rather than the intricate details of everyday life in the hospitals.—C. S. B.



FIGURE 33. Dr. Rudolph Matas, visiting Ashford General Hospital, White Sulphur Springs, W Va., in 1944, points out the "Matas Compressor" used to stimulate collateral circulation.

ning of World War II, the consultant system was not well established. Col. —later Brig. Gen.) Fred W. Rankin, MC, had much to do with the establishment of this system. He had charge of the Surgery Branch in the Office of the Surgeon General, but he had much to do with the extension of the system to the various sections of surgery. In the early period of the war, each service command surgeon had the power to say whether he wanted a surgical consultant. If the answer was "no," Colonel Rankin became persuasive to extend the system. No one who had known Colonel Rankin in civilian life would have recognized that he could be persuasive, but when it was for a purpose he could be persuasive.

In the course of time, there were consultants in surgery, medicine, orthopedics, psychiatry, and other specialized fields. Civilian consultants also were used (fig. 33). The latter did not wear the uniform, but they gave important service. Outstanding among the civilian consultants was Dr. Sterling Bunnell who not only originated many of the operations on the hand but gave lectures, conducted clinics, and performed or supervised many operations on the hand in Army hospitals. Dr. Bunnell made one of the important contributions to the surgery of the war. This type of contribution was a "natural" because the developmental period of these specialized operations occurred in the

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quiet of civilian life, and then widespread application came with the thousands of hands wounded in the war.

The Society for Medical Consultants came into existence after the war. This group holds regular meetings for discussion of problems, and, at frequent intervals, consultants are sent to medical facilities in Europe and the East where they work in their own fields, give lectures, and make reports which are widely distributed. In this way, the quality of the medicine is brought to light, the morale of the Medical Corps is given a boost, and the service is improved. The consultant system was weak in the early period of the war, but it became well established later in the war and exists today as a necessary part of the U.S. Army Medical Service.

DUTIES AND RESPONSIBILITIES OF THE SURGICAL CONSULTANT

The duties of the surgical consultant were not defined when Colonel Beck was assigned to the Fifth Service Command. When Colonel Beck arrived in his assignment, it was obvious that he was not needed, and he also felt that he was not wanted. The first favorable reaction from the surgeon came when Colonel Beck told him that he wanted to be assigned overseas with the Army.

The office to which Colonel Beck was assigned used the mail and telephone for communication with the various medical installations. There were few, if any, personal visits to these installations. Commanding officers were called in to service command headquarters for occasional meetings, but the process was not reversed. Colonel Beck attended these meetings and the discussions pertained to matters of organization and explanation of directives from Washington. The service command surgeon did the talking. The meetings were formal and served little purpose. There was no freedom of discussion, and it appeared that the care of the sick or wounded soldier was not the chief concern. Colonel Beck was never introduced at these meetings, and he was never invited to make comment or to discuss any subject. The Regular Army officers from the field were hesitant to speak out and ask questions, and the surgeon's office in turn seemed hesitant to speak freely with the Office of the Surgeon General.

After Colonel Beck had acquired some experience, he understood that this was the Army. There was no doubt in the mind of anyone running the office to which Colonel Beck was assigned that it was adequate in all its various functions. A big and important job of organization was being done, and it was not necessary to have a surgical consultant who might have access to Washington. Colonel Beck started from scratch.

One experience, which the author remembers, might be worth notation. It was his first visit to Camp Campbell, Ky. This was one of the large camps

and was situated between Kentucky and Tennessee, miles away from the railroad station. The new consultant arrived at the railroad station at 2 o'clock in the morning. He had difficulty in getting in touch with the camp to get transportation. After he arrived at the camp, the driver suggested that Colonel Beck get in touch with the officer of the day for a room for the rest of the night. Then Colonel Beck introduced himself to the commanding officers of the camp and hospital and began with his work. These preliminary problems are cited as examples of unnecessary difficulties that existed and of the lack of planning at that time.

The duties of the surgical consultant covered considerable territory, but they were restricted entirely to making a report. In other words, the report terminated the consultant's responsibility. If an undesirable condition continued to exist at the time of the next visit, it could be reported again. Never was there any attempt to change the consultant's report or to interfere with the writing of it in any way. If the condition was not corrected, the consultant never attempted to use other methods, and there were a few instances when correction was not made. In some instances, remedial action was slow, but almost always something was done about every important recommendation.

The Consultant's Report

The consultant's report was composed of six parts, as follows:

1. General considerations, including comment on the hospital as a plant—the wards, operating rooms, cleanliness, and so forth.

2. Surgical personnel, including a sketch of the training and competence of everyone on the surgical service and his surgical specialties with his rating, background in surgery, and so forth.

3. Census of patients.

4. Detailed discussion of professional work, general surgery, and surgical specialties, including the quality of the work, types of surgical conditions, the number of patients, the backlog of patients to be treated, personnel needs, problem cases, and so forth. Individual patients were examined. Suggestions were made for the correction of any professional, personnel, or hospital problems that existed. X-ray, anesthesia, and pathology were included in this survey. The autopsy examinations and also reference to surgical deaths were included. In one of the reports, the backlog in general surgery was 92, that in orthopedic service 27, and that in neurosurgery 400. This lopsided situation called for the shifting of personnel from one service to another.

5. Medical meetings, library, and medical journals.

6. Summary and conclusions, presenting every possibility for improvement. This required judgment to separate the important items from the unimportant items.

EARLY PROBLEMS—THE TRAINING CAMPS

As Colonel Beck looked back over his experiences, he could see readily that the activities of the Medical Department were those that pertained to (1) the care of soldiers in training, (2) the care of those wounded in war, and (3) rehabilitation and care after the war was terminated. The problems in each of these categories were related to the stage of the war. There was some overlapping, but essentially they were different.

The early problems in the training camps were without number. Things happened very fast; medical officers were in short supply; often they were available for only brief periods of time. Later on, the census of an entire camp might fall, in a period of months, from a very large number to almost none.

The most important problems in the training camp hospitals were related to drafted soldiers who did not want to be soldiers. Many devices were used such as feigning backache, developing enuresis, resorting to self-inflicted wounds, and so on. The backache and bed-wetting problems were important because these individuals occupied several hundred beds in the large station hospitals. It was necessary to differentiate those who had a pathological lesion producing the symptoms from those who did not, and this involved much work and expense. It took some time for medical personnel to learn how to make this differentiation without too much delay. After the differentiation was made, the problem of disposition remained for the Army, and this was also a serious problem.

In one of the station hospitals, the chief of surgery performed appendectomies without pathological changes in the appendix, and about 100 beds were occupied by such patients. This officer had to learn that appendectomy was not a prophylactic operation. In another hospital, there was an epidemic of mumps and orchitis, and an enterprising medical officer thought it would be scientific and educational to do biopsies on the testicle. This officer learned that the taxpayer could not afford unnecessary operations with their pension aspects later on.

A great variety of problems were encountered involving individual cases. The following incidents can be recalled. A soldier developed acute appendicitis. On the way to the hospital, he received a hypodermic injection of morphine. The correct diagnosis was not made, and the patient died. One death was due to a small stab wound of the heart, and there was no operation. Several cases of subdural hematoma were not recognized. Another patient died from hemorrhage after a spinal fluid tap through the foramen magnum. It serves no purpose to recount these occurrences; suffice it to say that they were brought to light and did not remain hidden and that the consultant system was largely responsible for bringing these mistakes into the open. At times, there were no medical personnel adequate for the responsibilities imposed; the personnel were changing rapidly and the best effort

consisted in using what was available. But the consultant had discussion of the problem, and on some occasions an officer was sent in from a nearby general hospital to take care of an urgent condition in a station hospital.

There were several instances of inadequacy on the part of the commanding officer of the smaller facilities. There were also instances of an inadequate officer having been assigned as chief of the surgical service. Such mistakes produced results that were often obvious, and, as a rule, correction was readily made. An inadequate commanding officer or chief of surgical service could do considerable harm to the proper conduct of the hospital. The one and only way to find out about a medical officer was to watch him in action and see what he did. There were occasions when former friendships and a pleasant personality were the factors on which assignment in a hospital was made. Three of these assignments produced considerable turmoil, but in the course of time they were corrected. With respect to conduct of hospitals and medical schools, the Army acted much more expeditiously and with much more wisdom than did the trustees of our civilian medical institutions. Indeed there was no comparison in the conduct of military and civilian institutions. It would be good for society as a whole if our medical institutions, including the medical schools, were subjected to the same critical analysis by competent consultants as were the military medical institutions during the war.

THE AIRBASE HOSPITALS

Colonel Beck visited a number of station hospitals located at airbases. He understood that the Army Air Forces expected to have their own general hospitals, and this seemed to be the program in the early part of the war. Assigned to these hospitals were large numbers of highly trained medical personnel. For the most part they had little work to do, and later some of these officers were made available to the Army Service Forces where they were needed. It was a serious mistake in Army organization to try to separate these services. These medical personnel were needed by the Army Ground and Service Forces.

THE GENERAL HOSPITALS

The general hospitals were organized primarily for the care of those wounded in war. These hospitals were usually large installations with a bed capacity of about 3,000. Location was based upon civilian population so that the wounded soldier could be hospitalized near his home. Several large station hospitals were converted into general hospitals after the camps were vacated. These hospitals were organized to give definitive treatment to those who needed it. The chiefs of services and other professional personnel were the best obtainable. In many instances, they were the outstanding surgeons of America. The organization was done with great care. The quality of the work in these hospitals was excellent. When specialized help was needed, such as for the hand, it was obtained. Consultants in surgery, orthopedics, psy-



FIGURE 34.—Sgt. Joco Montonio, medical illustrator at Ashford General Hospital, creating a bust of Gen. Jonathan M. Wainwright that was later cast in bronze for permanent retention as one of the Nation's treasures.

chiatry, and medicine supervised the work and disseminated knowledge from one hospital to another. Ancillary personnel at the general hospitals were highly skilled in their areas of specialization, and their talents were available in many fields (fig. 34).

There were, of course, many problems, but the most important problem was to keep abreast of the work. The most common type of injury was an open wound with bone infection. A patient with this type of injury arrived at the hospital with the extremity in a cast. The cast was immediately removed after arrival. The wound was cleansed, dead bone was removed, and a split-thickness skin graft was applied over the bone. The sulfonamides and penicillin were available and were used. These drugs helped to make this treament successful. In some cases, part of the skin graft sloughed away, but it was usually possible to convert the wound from an open one to a closed one. A cast was applied, after which the patient was sent home for a period of weeks or months.

The patient was then brought back to the hospital, as time permitted, and definitive surgery was done. Defects in the bone were filled with bone chips. This technique was developed by Maj. (later Lt. Col.) Marvin P. Knight, MC, at Crile General Hospital, Cleveland, Ohio. A full-thickness or a sliding skin graft was applied to cover the bone. This early cover of the wound was not en-

tirely new, but Colonel Beck's first contact with it was at Ashford General Hospital, White Sulphur Springs, W. Va., where it was employed by Maj. (later Lt. Col.) Robert P. Kelly, Jr., MC, and at Billings General Hospital, Fort Benjamin Harrison, Ind., where it was used by 1st Lt. (later Capt.) Ernest M. Burgess, MC. When its value was recognized, Colonel Beck extended this method throughout the command by sending officers to these hospitals for temporary duty. The method was presented at a medical meeting for the medical officers of the Fifth Service Command which was held at Newton D. Baker General Hospital, Martinsburg, W. Va., in May of 1945, and from there its use was extended to the other service commands by Col. I. Mims Gage, MC, Col. W. Barclay Parsons, MC, Lt. Col. (later Col.) Condict W. Cutler, Jr., MC, Col. Walter D. Wise, MC, and Col. Leonard T. Peterson, MC.

This method of treatment increased the bed capacity of each general hospital by as many as several hundred beds by making it possible for the patients to leave the hospital and return later when operation could be done as a routine procedure without exceeding the facilities of each hospital. This program saved the Fifth Service Command the equivalent of one general hospital. The consultant was pleased to have been instrumental in this development.

Colonel Beck had difficulty in arranging the aforementioned meeting. The treatment of osteomyelitis was not sufficient reason to persuade the service command surgeon to give permission for such a meeting. Later on, the consultant did succeed in arranging a urological conference and symposium on the paralyzed patient. The treatment of osteomyelitis was put on the program as a subject of secondary importance, but it was presented at this conference. This was the first meeting for discussion of professional problems with which Colonel Beck had any contact in the Army. There were several meetings of the surgical consultants in the Office of the Surgeon General, but these concerned matters of policy rather than the surgical care of patients. The need for such a meeting was great, and this meeting yielded more than small results.

Some of the most difficult problems were the injuries that involved the urological system. A competent urologist was not available for every general hospital, but it did become possible to place a competent urologist on temporary duty at other hospitals as necessary. This was a good idea, and it worked out very satisfactorily.

Great effort was made for the care of the paralyzed patient. All kinds of services were brought to bear upon these patients. These included the services of the neurosurgeon, urologist, orthopedist, general surgeon, psychiatrist, nutritionist, and rehabilitation personnel.

Specialization

Some of the hospitals were designated for special services. Thus, Ashford General Hospital (fig. 35) was a vascular center, several hospitals were designated as neurosurgical centers, and several, as plastic surgical centers. For various reasons, this was a necessary development. Highly qualified personnel



FIGURE 35.—Ashford General Hospital, White Sulphur Springs, W.Va., formerly the Greenbrier Hotel

were assigned to these special services. The other general hospitals transferred patients to these centers. This became a requirement, and it was closely observed by this consultant.

GENERAL IMPRESSION

In writing this history, it has been necessary to recall as many experiences as possible. Time has added both highlights and shadows to these experiences. The important things still stand out in memory, while the relatively unimportant things are gone.

No man placed in an important assignment does a perfect job, and, likewise, no big organization can ever do a job that is completely perfect. It could always be done better. Regardless of how perfect the record can be made to read, the work actually is never perfect.

The record for the Fifth Service Command was not perfect. It was very imperfect in the early part of the war. The imperfections due to bad judgment were susceptible to correction, and they were corrected. The others inherent in the rapid building of an Army had been scarcely correctible in years gone by and probably will not be correctible in the future. Many factors were responsible for the early inadequacy, and these need not be enumerated here.

The general hospitals, however, were something that this country can point to with pride and satisfaction. The amount of work done and the quality of the work done in the general hospitals stand as a great monument to medicine in wartime. If comparison is possible, it can be stated with considerable assur

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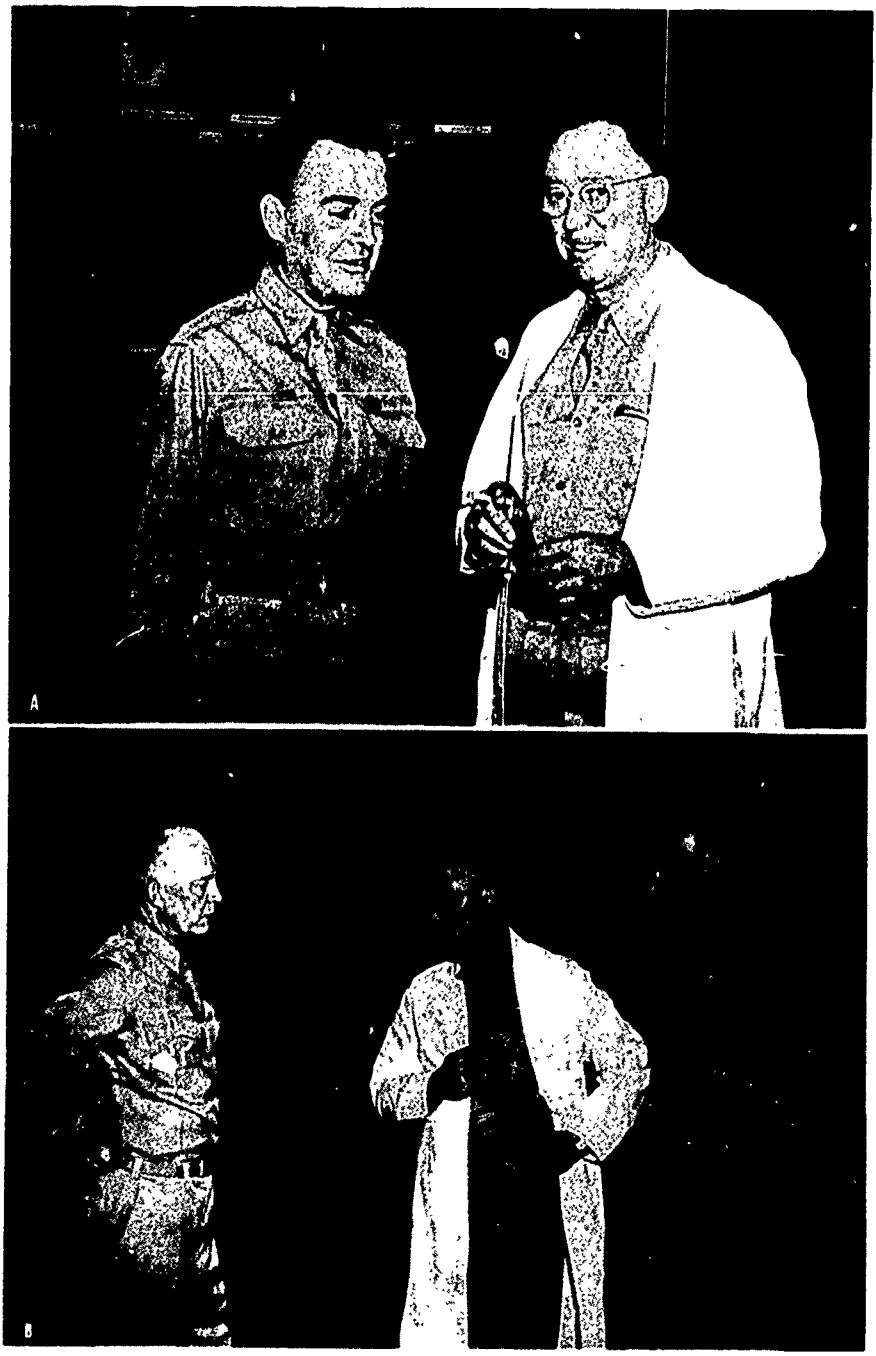


FIGURE 36. *(See opposite page for legends.)*

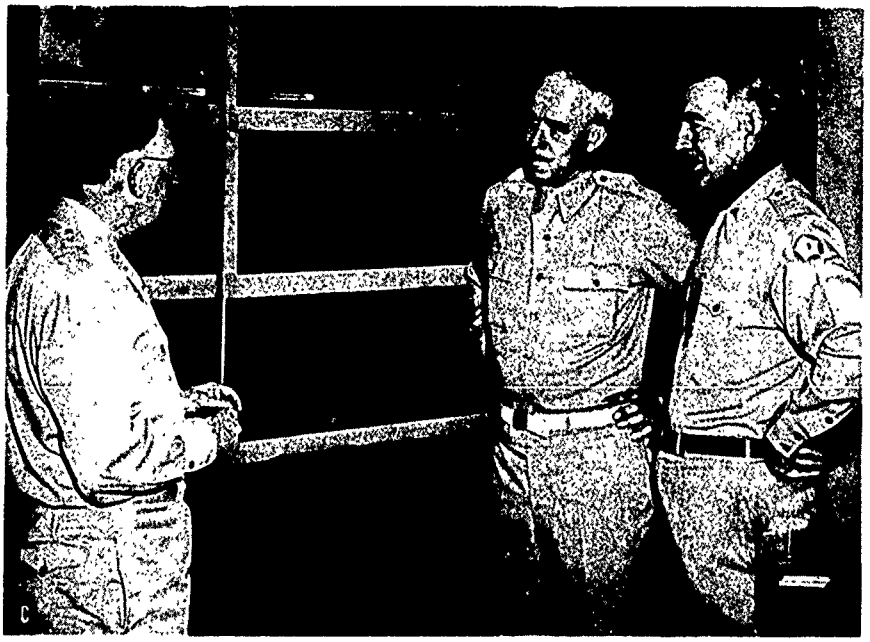


FIGURE 36.—Ashford General Hospital, being easily accessible from Washington, presented an opportunity to show Army dignitaries the superior services being rendered at Army general hospitals. A. Col. Daniel C. Elkin, MC, chief of surgical service, explains to Maj. Gen. Anthony C. McAuliffe, hero of the siege of Bastogne, some of the outstanding work done at Ashford. B. Colonel Elkin and the hospital commander, Col. Clyde McK. Beck, MC, show the incoming Army Chief of Staff, General of the Army Dwight D. Eisenhower, the facilities available at the hospital. C. Colonels Beck and Elkin orient the incoming director of the Veterans' Administration, Gen. Omar N. Bradley, on the services provided in Army general hospitals.

ance that these hospitals easily surpassed the best civilian hospitals of that period. The members of the Medical Corps who served in these hospitals took pride in their accomplishments (fig. 36). They knew that it was the care of the patient that came first. These medical officers also knew that organization was necessary so that the work could be done, and this organization of which they were a part was as good as could be achieved.

Personally, this consultant had satisfaction in his assignment. The Army organization made it possible for him to be effective. He knew that his work was well regarded by General Rankin. General Rankin and Col. (later Maj. Gen.) Edward A. Noyes, in the Fifth Service Command, deserved a large part of the credit for Colonel Beck's services. An important source of satisfaction was the contacts with the medical officers in the places where they worked. Colonel Beck was someone who could be talked to in private as an individual without relationship to Army rank. Many a problem, small to the

hospital but important to the officer, was solved on the basis of such meetings. Everyone needs a friend, and a young doctor who had been uprooted from his environment was in special need of someone who could understand him. Some of the problems brought to light by these private conversations were, indeed, important to the hospital.

The author's final advice is to let the light of understanding be cast upon the problem. Then it can be solved. As long as the problem is hidden it defies solution and often remains as a torment working against the best of effort and the highest fulfillment of duty.

CHAPTER XII

Seventh Service Command

Grover C. Penberthy, M.D.

As a Reserve officer, Col. Grover C. Penberthy, MC, was informed early in June 1942 of the establishment of a consultant service which was to be a part of the Medical Department. He was requested to accept a duty assignment as a consultant to one of the nine corps areas, later designated as service commands, of the ASF (Army Service Forces). His orders to active duty in the Seventh Corps Area were contained in War Department Special Orders No. 175, dated 2 July 1942. Colonel Penberthy reported for active duty at Fort Wayne, Detroit, Mich., on 25 July and joined Headquarters, Seventh Corps Area, Omaha, Nebr., on 29 July 1942.

Colonel Penberthy remained in this assignment throughout the war. It was a pleasant experience marked by cooperation of the personnel, both military and civilian, at Seventh Service Command headquarters and in installations and facilities visited within the command. Appreciation is expressed for the cooperation and support given by Maj. Gen. C. H. Danielson and Maj. Gen. Louis A. Craig who were, in turn, commanding generals, and by Col. (later Brig. Gen.) Sidney Erickson and Brig. Gen. Paul X. English who were, in turn, chiefs of staff of the Seventh Service Command. Appreciation is also expressed for the cooperation and support given by Col. Herbert C. Gibner, MC, Col. Harvard C. Moore, MC, and Col. Charles R. Mueller, MC, who were, in turn, service command surgeons; by Col. Neill J. Everitt, MC, assistant to the surgeon; and by the officers in the surgeon's office.

Inasmuch as there was no set pattern for the consultant's activity as applied to hospital surgical services, except that of a well-run civilian hospital, the continued spirit of cordiality and cooperation shown by the Office of the Surgeon General and the associated officers at Headquarters, Seventh Service Command, helped materially to carry through the concepts of this additional Medical Department service which the assignment of the consultant represented. It also afforded an opportunity to evaluate the results of the superior educational programs carried on in the medical schools, combined with the advanced intern and resident training in the hospitals.

SCOPE OF ACTIVITIES OF THE SURGICAL CONSULTANT

Colonel Penberthy's activities were carried out principally in the field of visiting both the ASF and the AAF (Army Air Forces) installations and activities. These included 4 general and 58 station hospitals, with the break-

down of the latter as follows: 16 ASF station hospitals, 32 AAF station hospitals, and 10 station hospitals at prisoner-of-war camps. The station hospital at Camp Carson, Colo., was designated as a general hospital early in 1945, and eight of the station hospitals (four ASF and four AAF) were subsequently classified as regional hospitals. In December 1944, the key officer personnel assigned to these regional hospitals, through the joint action of the ASF, the AAF, the AGF (Army Ground Forces), and the ATC (Air Transport Command), were named as subconsultants to visit their respective satellite station hospitals. This arrangement made possible more frequent professional visits to the satellite hospitals and relieved the surgical consultant at a time when general hospitals were receiving more battle casualties and when much of the major surgery originating in the Zone of Interior was being concentrated in the regional hospitals. The number of Colonel Penberthy's hospital visits each year varied from 88 to 100.

Visits were also made at times to most of the seven induction stations, which were subsequently reduced in number to meet the reduced inductee input. Dispensaries, such as the Kansas City General Dispensary, were visited from time to time.

The principal public relations activity consisted of participation in nonmilitary medical programs, including the War-Time Graduate Medical Meetings; lending support to local, State, and national meetings; and representing the commanding general or service command surgeon at specific functions.

The principal contribution of the surgical consultant was made in the field. His field trips entailed considerable travel—chiefly by rail or automobile, and later by military airplane—over an area including nine States, extending east and west from the Mississippi to the Rocky Mountains and north and south from the Canadian boundary to the Arkansas State line. Because he spent so much time away from the service command surgeon's office, the extent of administrative duties assigned the consultant was minimal. He served in an advisory capacity relative to medical policies, classification of Medical Corps officers, and assignment of Medical Corps officers to ASF installations and hospital units being assembled for oversea duty.

Reports of Inspection

The consultant submitted a written, detailed report of each inspection he made in the field. His report on an ASF facility was submitted to the station surgeon, the service command surgeon, and The Surgeon General; that on an AAF installation was submitted to the station surgeon for such disposition as was indicated by AAF authority. Usually, the report was sent to the commanding general of the Army Air Forces, for the attention of the Air Surgeon. The inspections were reported under the following headings:

1. Authority for inspection.

2. Hospital plant (consideration of the general setup, bed capacity (normal and possible expansion), census, alterations or new construction, problems, policies, and so forth).

3. Personnel (numerical and professional adequacy of officers assigned to the surgical service).

4. Training (professional and technical programs and conferences).

5. Surgical service (a description of the overall setup, patient load of the respective sections, cases presented and discussed on ward rounds in each section, and consideration of problems pertaining to the service).

6. X-ray (type and adequacy of the equipment, workload, and personnel, including trainees).

7. Operating room (adequacy of equipment, which was limited and inadequate in the early period of the war but more or less complete near the end; types of anesthetics administered, complications if any, the workload per month, personnel assigned, and the training program for enlisted men).

8. Physiotherapy (equipment installed, personnel assigned, workload, and training program in force).

9. Professional care (discussion of care being given in the wards and special cases requiring consultation).

10. Disposition boards (meetings held, number of cases reviewed, and promptness of disposition).

11. Records (universally found to be complete).

12. Library (a good variety of bound textbooks and medical journals representing the specialties was available).

13. Nurses.

14. Enlisted personnel (number assigned, specific training programs conducted for technicians, orientation lectures and demonstrations, and rotation among the various sections).

15. WAC (Women's Army Corps) personnel assigned.

16. Summary and evaluation of professional service.

PROFESSIONAL SERVICES

Service command surgical consultant.—The military consultants, when ordered to active duty, were charged with carrying out the following which had been proposed as a definition of their functions and responsibilities: "Act in an inspectorial and consultative capacity; the duties shall include the evaluation of the professional qualifications of medical personnel, appraisal of therapeutic and diagnostic procedures and agents, and the coordination of professional practice by local discussion with hospital staffs of such special problems as may present themselves." The chief function of the surgical consultant was, therefore, the evaluation and supervision of professional services. To this end, when the consultant visited hospitals, most of the patients

on the surgical services were presented to him on ward rounds in the respective sections.

Informal discussions often developed with special or selected cases relative not only to the diagnosis and treatment but to the disposition of such cases as well. Reference has already been made to the opportunity afforded the consultant to evaluate the results of the prevailing high standard of resident training. With few exceptions this training was apparent at most hospitals and was manifested in the approach made by the officers in arriving at a diagnosis—particularly in problem cases, their overall understanding of the particular surgical problem, and the subsequent surgical management. The writer can say with certainty that he has benefited professionally many times as a result of his wartime experiences as a consultant.

In addition to the ward activity and conferences, an informal meeting was usually held with the medical officers at which time Colonel Penberthy presented some subject or participated in the program by entering into the discussion of some subject presented by a duty officer of the hospital being visited.

Colonel Penberthy participated in the AAF orthopedic conferences in the fall of 1943 at Buckley Field, Denver, Colo., Lincoln Army Air Field, Lincoln, Nebr., and Jefferson Barracks, Mo., presenting the subject of burn therapy. At the AAF surgical conference in September 1944 at Lincoln Army Air Field, he presented the subject of wound healing.

Civilian consultants.—This additional consultation service was inaugurated by The Surgeon General late in 1943. It was Colonel Penberthy's privilege to accompany the civilian surgeons in their visits to medical activities in the Seventh Service Command. Dr. Robert D. Schrock, orthopedic surgeon of Omaha, Nebr., in December 1943, visited station hospitals at Lincoln Army Air Field, Camp Carson, Colo., and Camp Hale, Colo., and Fitzsimons General Hospital, Denver, Colo. Dr. Frank D. Dickson, orthopedic surgeon of Kansas City, Mo., in January 1944, visited Winter General Hospital, Topeka, Kans., and O'Reilly General Hospital, Springfield, Mo., and the station hospitals at Fort Riley, Kans., Camp Phillips, Kans., Fort Leonard Wood, Mo., and Camp Crowder, Mo. Dr. William Jason Mixter, neurosurgeon from Boston, Mass., inspected the neurosurgical service at O'Reilly General Hospital on 3 July 1944. In September 1945, Dr. Schrock again visited the orthopedic services at Schick General Hospital, Clinton, Iowa, and at O'Reilly and Winter General Hospitals. The contributions made by these surgeons were constructive and most important. Each submitted a report on his visits. The officers at all installations gave unanimous, favorable expression to this additional consultation service. In turn, the civilian consultants no doubt benefited and couldn't help but be impressed with the superior quality of the surgical service being rendered by the officers in these two major branches of surgery.

The temporary service of Dr. Sterling Bunnell in the Seventh Service Command to conduct conferences on surgery of the hand was another outstanding contribution. Two such conferences, with an intensive program extending through 4 days, were held at O'Reilly General Hospital in February and August of 1945. The course consisted of didactic lectures illustrated by lantern slides depicting the anatomy and physiology of the hand, diagnostic and clinical conferences, and operative clinics. The officers in attendance were from installations of both the ASF and AAF and numbered 27 for the February refresher course. For the course in August, 37 medical officers from ASF facilities and 11 from the AAF attended. The officer personnel on duty at O'Reilly General Hospital were also in attendance, which gave an overall enrollment for each course of approximately 70. The available clinical material, of great variety, was inexhaustible. There were 200 to 300 crippled hands in the wards, not including a large group of brachial plexus and other neurological injuries. At the clinical conferences, free discussion was encouraged after Dr. Bunnell's presentation of the cases and their evaluation relative to possible surgical procedures to restore at least partial function of the injured member. The benefits derived by the officers in attendance would be difficult to evaluate, except that it was observed that many returned to their respective surgical services with a new interest, a new enthusiasm, and a better concept of the surgical management of the crippled hand. In a few of the hospitals, hand clinics were set up for discussion and evaluation of new cases and postoperative results.

War-Time Graduate Medical Meetings.—Colonel Penberthy participated in two programs in Denver of the War-Time Graduate Medical Meetings. Dr. Charles G. Johnston, Professor of Surgery at Wayne State University College of Medicine, Detroit, Mich., accompanied Colonel Penberthy in June 1946 and met with medical officers at the regional hospitals at Camp Crowder and Fort Leonard Wood and at O'Reilly General Hospital. In addition to ward conferences with discussion of cases, Doctor Johnston presented the subject of intestinal obstruction at a general meeting. This presentation was supplemented by a motion picture depicting the use of the Miller-Abbott tube, which emphasized statistically the disadvantages and advantages to be gained by its use in selected cases.

Promotions and morale.—The surgical consultant shared in sponsoring recommendations for promotion of worthy officers in consultation with the service command surgeon, with Colonel Everitt, assistant to the surgeon and in charge of officer personnel, and with the medical consultant. In many instances, opportunities for promotion were inadequate, due perhaps to the fact that too little attention, apparently, had been given to this deserving activity by those responsible. Many medical officers with long periods of preparation for their duties had entered active military duty equipped and trained to render competent professional service, but in many cases these facts, unfortunately, were not given proper recognition.

The need for the maintenance of morale became apparent early and was more noticeable in the later months. Colonel Penberthy made every attempt to maintain a high level of morale by encouraging presentation of personal problems to him, by commendation for work well done, by a change of station or assignment to an oversea unit in individual cases insofar as this was possible and advisable, and by encouraging officers to submit experiences and observations for publication. Also, support was given to officers interested in securing places on national medical programs.

Manuscripts.—Many manuscripts prepared by officers on surgical subjects were reviewed and either returned with comment or forwarded to the Office of the Surgeon General for consideration. Encouragement was given to the officers to submit their experiences for publication.

Relation of the surgical consultant to the commanding officers of hospitals and chiefs of surgical service.—Colonel Penberthy's association with commanding officers and chiefs of surgical services in the various hospitals was a friendly one. Problems, both professional and pertaining to personnel, were discussed informally. The position taken by the consultant was to lend support to the respective installations being visited, rather than to be critical. Mutual understanding between those in authority at the hospitals and the consultant was productive of beneficial results and the establishment of a sound relationship with the service command surgeon's office. Informal correspondence between hospital commanders and chiefs of surgical services and the consultant was encouraged, except where official matters discussed would require the information to be forwarded through channels. The understanding and leadership of both the commanding officers and the chiefs of surgical service were reflected in the general setup and in the contribution made by the various hospitals.

SURGICAL PROBLEMS OF INTEREST

The surgical services, with perhaps a few exceptions, throughout the command in both the ASF and AAF hospitals were considered superior. This superiority was reflected in the high standard of surgical practice which was maintained and in the comparatively low incidence of serious complications. Surgical mortality was reported to be minimal.

The more common conditions requiring surgical operation during the period when troops were in training were for hernia and appendicitis. The incidence of both was apparently high in the larger camps.

Hernia.—The frequency of hernia operations and the low incidence of recurrences following operation was shown in statistics for the year 1943. Sixty-seven hospitals, which included station and general hospitals, replied to a questionnaire and reported 3,996 operations performed for the correction of inguinal hernia (some bilateral). There were 11 recurrences reported from 10 hospitals. Four cases had previously been operated on, and of this num-

ber two had been operated upon previously on two occasions. Some of the recurrences had been operated on elsewhere in Army hospitals. The low incidence of recurrences reported—none at all in some instances—was explained by the fact that many of the postoperative cases were in time moved to other stations, a consequence of which was that the followup was limited.

Appendicitis.—The incidence of this surgical lesion was perhaps no higher than would be seen in a comparable civilian population, but the number of operations performed did appear to be relatively high. This may be explained by the fact that the soldier who reported to sick call was hospitalized early in this illness in most instances and encouragement was given to operation when the clinical and physical findings warranted a diagnosis of appendicitis. This did not mean that unnecessary operations were performed, but following this program of management no doubt contributed to a minimum of complications and also to the low mortality. In many instances, patients with complications had not been seen until late in their illness. They had been transferred from another station where they had not reported ill for fear of not being included with their associates in changes of station.

Pilonidal cyst disease.—The incidence of infected pilonidal cyst with draining sinus tracts was comparatively high during the training period of the Army, especially at the larger stations. There were many instances of long periods of morbidity and a resultant loss of duty time in the early months of the war. The lesion had seldom been seen in the surgical clinics during World War I, and, because of the high incidence in World War II, many theories were advanced as to possible contributing factors, such as riding in jeeps, trucks, airplanes, and other vehicles. These conclusions, however, were not always valid, as many patients admitted for surgical care gave no history of exposure to possible trauma from such causes.

Experiences with this lesion as reported from a general and a station hospital may be considered representative of those of other clinics. The general hospital reported the following:

> A complete comprehensive study was made of 102 patients. The pilonidal cyst, although considered a congenital anomaly consisting essentially of embryonic inclusion of skin structure in the subcutaneous tissues of the sacrococcygeal area, appeared primarily in the age group 20 to 30 years. The loss of duty time and manpower were evaluated in this study, which showed that 90 lost on an average of 5 months, 75 men lost five-and-a-half months and 6 lost more than 1 year; the longest reported time lost was seventeen-and-a-quarter and seventeen-and-a-half months.

At the time of this particular visit in April 1943, it was reported that 40 of the 45 in the service in September 1942 had been before the disposition board and had been discharged to a duty status.

The following experience was reported at the AAF station hospital:

> 132 cases were operated upon from the time of the opening of the hospital August 6, 1942 to September 1944. Before the present form of treatment was instituted following the SGO Circular Letter No. 169, September 25, 1943, subject Pilonidal Cyst and Sinus, 33 cases were reviewed and it was found that the average hospital stay was 57.5 days, 18

having been hospitalized 99 days, the longest, 158 and the shortest, 12 days. The acute cases are only incised and drained. Excision was practiced subsequently in 71 cases with 4 reported as failures. The average hospital stay for the first operation has been 9.1 days and for the second, 18.4 or 27.5 days in all. The excised cases were closed using cotton sutures without retention sutures, and the patient was kept in bed 12 days.

The postoperative cases presented on ward rounds at the time of this visit showed the wounds to be clean and healed. The skin at the site of the scar was freely movable. The conservative management, as outlined and observed throughout the command, materially shortened the period of morbidity, and the loss of duty time was kept to a minimum. Improvement in the surgical management of this group of patients was further noticeable following the circulation of War Department Technical Bulletin (TB MED) 89, Pilonidal Cyst and Sinus, dated 2 September 1944.

Fractures.—Training activities developed a variety of fractures which were handled in much the same way as in civilian practice. Skeletal traction was emphasized in the management of selected fractures of the long bones, although plaster immobilization was no doubt more commonly used. Early ambulation was universally practiced where it was practicable, with various types of walking supports, such as the walking iron, a rocker arrangement, a rubber heel, or a piece of an old rubber tire casing. There was nothing unusual observed in the treatment of fractures except for the problem of delayed union, which attracted attention simultaneously at two stations; namely, Station Hospital (changed on 18 June 1944 to Army Air Forces Regional Hospital), Buckley Field, Denver, Colo., where the altitude was about 5,000 feet, and Camp Hale, where the altitude was reported to be over 9,000 feet. No satisfactory explanation was arrived at, although it was observed that some patients who had come originally from a lower altitude manifested X-ray evidence of delayed union. The majority of the fractures treated at Camp Hale were of the lower extremities close to or above the ankle joint and were the result of skiing accidents.

Knee injuries.—This group of injuries, particularly meniscal tears and ligamentous rupture, comprised a very considerable portion of the operative material during the training period at several of the camps. It became apparent early that meniscal removal as a rule was seldom followed by return to full duty status in less than 3 or 4 months. For this reason, more conservative therapy was instituted, and surgical treatment was resorted to only when the patient had a history of recurrent disability. It was further found that operative ligamentous reconstruction in the absence of arthritic changes could restore otherwise permanently disabled knees to a limited duty status.

Other problems.—There were many other interesting surgical problems and numerous instances of outstanding achievement in the Seventh Service Command. Fractures of the femur, trenchfoot, and hand surgery deserve mention in this connection, but these subjects have been covered in detail in other volumes of the clinical series of the history of the Medical Department, United States Army, World War II.

COMMENT

Colonel Penberthy's assignment to duty in the Seventh Corps Area, later designated as the Seventh Service Command, in July 1942 as the surgical consultant was enjoyable and, in many respects, profitable. The reception given him at the many stations and hospitals visited from time to time was friendly. The exceptions were few and came early in his experience when it was possible that there was a misunderstanding of the responsibility and position of such an officer. The resistance was minimal, and in most instances good cooperation was given the consultant by both the commanding officers and those engaged in the professional and administrative work.

The purpose of the consultant service was intended to be constructive, and every attempt was made to fulfill the desired purpose. The overall professional surgical service was maintained at a high standard. Weaknesses, where noticeable, were easily corrected. The high type of surgery performed and the clear judgment shown by medical officers clearly demonstrated the results of higher education and the good intern and resident training.

In looking back with the idea of forming some constructive suggestions from his experience, the writer has little to offer as an improvement over the teamwork (group practice) developed by officers in various hospitals, especially where key personnel were kept intact.

The changes in personnel made to meet the needs and exigencies of war often temporarily disrupted a service, but generally the change was made with no appreciable lowering of the high standard of surgical care given the patients.

The program of professional training as directed by The Surgeon General and carried out by the hospital commanding officers and chiefs of services provided an excellent opportunity for the continuance of one's education. The program gave officers the privilege of participation, thereby adding, no doubt, to their own security. Although there was the need for assigning medical officers to combat units, it often occurred to Colonel Penberthy that sufficient consideration was not given to a selected group of already partially trained young officers in the various surgical specialties to continue in their respective fields to meet postwar professional needs and to replace trained surgeons deserving of consideration for early return to civilian practice.

The morale of medical officers throughout most of the active period of war was good, with a few exceptions where promotions on the basis of age and contribution were not given proper and full consideration. With the end of active warfare, the morale problem stemming from the small number of promotions was intensified; although there was no noticeable letdown in professional care given the sick soldier, one sensed an apparent feeling, on the part of the officers, of indifference to their responsibilities. This lack of interest on the part of some of those who were responsible for giving recognition by promotion for services rendered was in part corrected. However, for the

overall benefit in stimulating interest, it is believed that the change of viewpoint came too late. The need for good morale was understood by all. In the future, in the event it becomes necessary to enlist the help of a similar, highly trained and patriotic group of civilian physicians, more recognition in the way of promotion will no doubt be given by the Department of the Army to maintain morale to a high degree in keeping with the traditions of the Army Medical Corps.

CHAPTER XIII

Eighth Service Command

Bradley L. Coley, M.D., Henry G. Hollenberg, M.D., and Thomas L. Waring, M.D.

Section I. The First Consultant, 1942–44[1]

PROBLEMS DURING THE TRAINING PERIOD, 1942–43

During the latter half of . . . and the entire year of 1943, the problems which faced Col. Bradley L. Coley, MC, as Consultant in Surgery, Eighth Service Command, were related largely to the surgical care of more than one million troops who were undergoing training in the service command.

One of these problems was to evaluate the skill and competence of medical officers assigned to the surgical services of the various station and general hospitals under jurisdiction of both the Eighth Service Command and the Army Air Force. Due to the frequent changes in personnel, the survey of hospital surgical services became a more or less continuous process. When deficiencies were found, a shifting of medical officers was often required.

During the first half of the war, many operations were performed for the correction of defects that had existed before induction. Sufficient care in the selection of cases for operation was not always taken by surgeons who had had no previous Army experience. Soldiers were often operated upon in these early days without regard for the necessity of their return to a combat unit. In many instances, an operation which, judged by civilian standards, was successful left the soldier incapable of continuing a rigorous training program. As a result, the final disposition was reclassification for limited service or even a certificate of disability for discharge. This experience taught medical officers that, in the Army, operations frequently should be withheld and that the personality and psychiatric background of the individual should be very carefully evaluated before proceeding with the correction of conditions existing prior to induction. Illustrative of conditions in this category were internal derangements of the knee, herniated disks, recurrent dislocations of the shoulder, varicose veins, and certain congenital defects, such as maldescent of the testis and pilonidal sinus. The last-named condition was responsible for great loss

[1] Col. Bradley L. Coley, MC, served as surgical consultant in the Eighth Service Command from the latter part of July 1942 to mid-March 1945, at which time he was succeeded by Col. Henry G. Hollenberg, MC. Colonel Coley's remarks pertain more to situations characteristic of the early and middle years of the war, while the comments of Colonel Hollenberg which follow were based on observations during the last year of the war.—B. N. C.

of manpower due to prolonged hospitalization following operation and frequent recurrences necessitating further operation.

The experience with pilonidal sinus in the Eighth Service Command was, no doubt, duplicated by observations of consultants in other service commands. At first, the general practice was excision with open packing of the wound, which was then supposed to heal by granulation. This technique was used on soldiers with symptomless sinuses that had never given the slightest trouble. Such prolonged delay in healing followed this method that partial closures, following the technique advocated by MacFee and by DePrisio, were popular for a time. Later on, excision and primary suture was employed with various modifications, such as the use of fascial flaps as attempted by Shute, Burch, and others. Many of these cases, that is, complete closure by suture, appeared to heal satisfactorily and remained so for considerable periods, only to reopen and drain again. The writer holds no brief for a particular technique, although experience has prejudiced him against wide excision and packing and against extensive fascial plastics. He is, however, convinced that patients with symptomless sinuses should never be operated upon and that incision and drainage, where necessary for infection, is all the surgery that is necessary.

In the first 9 months of 1942, there was an estimated loss of nearly thirty thousand man-days due to prolonged hospitalization for pilonidal sinus in 20 of the larger hospitals in the Eighth Service Command. At that time, the consultant proposed that no cases be operated upon unless their condition prevented participation in the active training program, and that simple measures be taken for inflamed cases. It was indicated that pilonidal sinus cases ought not have been accepted for full duty or that some better method of treatment than excision should have been devised. The wide variation in treatment employed for this condition was, in itself, testimony to the failure of any one method.

From the viewpoint of the consultant, the methods for screening inductees were seriously deficient. Too many soldiers were being admitted to hospitals for defects which were disqualifying beyond any question. Too large a daily load of examinations was being carried out by too small a group of civilian doctors at the induction stations. This manner of screening left little doubt that serious errors would be relatively common. If the national emergency had been less acute, it would have been better to have had a group of medical officers who had been especially trained to recognize disqualifying defects perform all selective physical examinations. More care at this level would have resulted in an enormous saving of man-days and public funds. It would have spared the expense of future care in Veterans' Administration facilities of men whose disabilities marked them as incapable for military service.

In this earlier period, most station hospitals had competent surgeons; but, as the number of units activated for oversea movement increased, the caliber of surgeons in station hospitals decreased steadily. The directives limiting the type of operations for elective conditions permitted in station hospitals

was a cause for considerable complaint on the part of the surgeons. At first, many of these surgeons were as competent as were the surgeons in general hospitals. As a result of this policy, however, the wholesale transfer of such cases of elective surgery from station to general hospitals soon began to overtax the latter. It was therefore found necessary to designate a few station hospitals as regional hospitals where certain types of surgical cases originating in the Zone of Interior were treated. By strengthening the staffs of these regional hospitals, adequate surgical care was assured. This modification worked well and seemed sound.

The 10 general hospitals of the Eighth Service Command were for the most part supplied with excellent specialists in the surgical fields and rendered service of high order. The establishment of centers for special types of surgery, for example, amputation centers, was a factor in obtaining the highest possible standards of surgical care.

With regard to Air Force hospitals, Colonel Coley acted merely in an advisory capacity, and his recommendations were not necessarily followed. At times, perhaps, his recommendations were not welcomed by higher medical echelons of the Army Air Forces. Nevertheless, relations between individual surgeons in the Air Force hospitals and the service command surgical consultant were uniformly cordial.

SPECIAL PROBLEMS

During the course of Colonel Coley's tenure as the surgical consultant, many special problems arose. A discussion of some of these problems follows.

Early ambulation.—At the outset, several large general hospitals were successfully practicing the policy of early ambulation. Interest in this method of postoperative management spread rapidly, despite the fact that the Office of the Surgeon General was opposed to it in hernia cases and was rather unfavorable toward it after other abdominal operations. As a result, several of these hospitals were unable to continue using the method, although their experience with it indicated that it was a definite advance.

Psychosomatic disorders.—It became progressively more evident that surgeons were often quite unfamiliar with the complexities of psychosomatic complaints. Often when individuals had been operated upon, the outcome was disappointing and resulted in a certificate of disability for discharge or a reclassification for limited service. Having learned by experience, some surgeons refused, except in cases of emergency, to operate on any patient in which there was question of a psychosomatic element until the patient had been seen by a neuropsychiatrist and a clearance for operation had been given.

Acute appendicitis.—In view of the large number of operations performed for this condition, the mortality rate in the Eighth Service Command seemed surprisingly low. There were, however, a sufficient number of deaths to stimulate the consultant to make a study of all cases coming to autopsy from hospitals in the service command. Although this investigation had not

been completed by the time Colonel Coley left for oversea service, the following impressions had been gained:

1. The most significant factor appeared to be delay in admission of cases to station hospitals. This was due to the reluctance or indifference on the part of the individual in seeking medical attention promptly. Less excusable were the occasional cases in which the dispensary doctor prescribed for the patient's complaints without examining the abdomen.

2. Reliance on local instillations of the sulfonamides and the systemic administration of penicillin to combat peritonitis led to the late recognition of secondary pelvic and subphrenic or subhepatic abscess. A number of cases survived for several weeks only to die of sepsis; autopsy revealed the presence of these undrained collections of pus. More strict compliance with the precept that a patient with abdominal distress or pain should never receive medication until the abdomen has been examined would have resulted in earlier operative interference. Perhaps posters could have been utilized warning the soldier of the necessity of reporting abdominal pain to the dispensary immediately.

Refusal of the soldier to undergo operation.—It was noticeable how frequently men undergoing basic training refused to have a hernia operation and how seldom disciplinary action was attempted to enforce the operation. This reluctance on the part of authorities to force the issue became common knowledge through the "grapevine," and the percentage of refusals increased sharply. It always seemed patently unfair to Colonel Coley to permit an otherwise healthy individual to escape the risk of foreign service because he feared the infinitely smaller risks of an operation for inguinal hernia and refused to submit to surgery.

Hand infections.—Hand and finger infections caused concern. Usually, they were seen routinely in the dispensary, and, too often they were treated there on an ambulatory basis. Incisions totally inadequate were made without anesthesia, and the resulting drainage was insufficient. As a result, the service command surgeon, on the advice of the surgical consultant, issued a directive to all installations that cases of hand infections, regardless of their triviality, be sent directly to the station hospital for observation, hospitalization, and appropriate treatment.

As a result of the consultant's experience with cases of hand infections, he offered the following suggestions:

1. All hand infections should be admitted to the hospital without delay, and none should be treated on an ambulatory basis in the dispensary.

2. It should be made a rule that all operations for hand infections be performed under a general anesthesia and with a tourniquet (preferably a blood pressure cuff pumped up to 280 mg. Hg).

3. Penicillin should be used at the earliest stage of even the most apparently trivial case of hand infection. (A few cases had been seen in which such

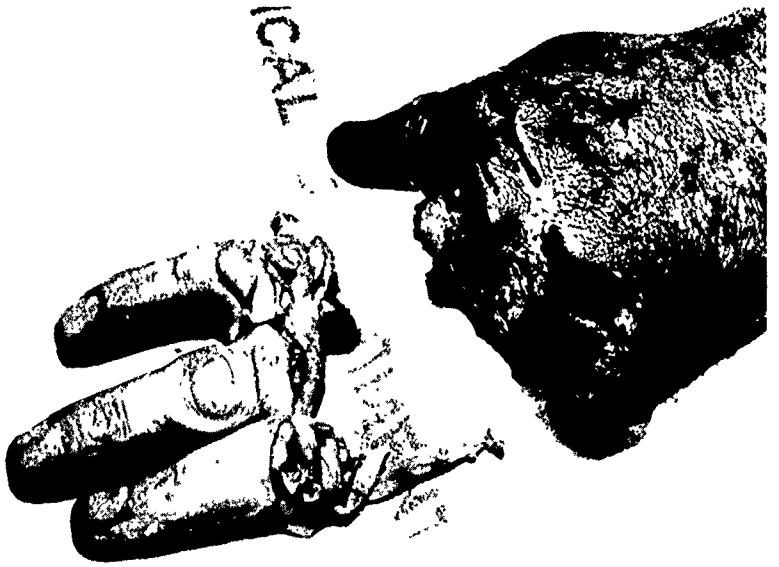


FIGURE 37.—Result of self-mutilation of the hand.

treatment seemed to abort an infection which at the outset appeared to be of a serious nature.)

4. The institution of courses for instructing surgeons about hand infections and hand injuries has proved a very valuable measure. Dr. Sterling Bunnell's contribution in this respect was outstanding. In the future, such courses should be set up early in the training period in order that trainees might receive instruction in the intelligent handling of these cases from the outset. It would have been an enormous help if Dr. Bunnell's courses could have been given in 1942 instead of 1945.

5. Consideration should be given the question whether hand infections, and especially hand injuries, would in the future be handled better by general surgeons than by orthopedic surgeons.

Self-inflicted wounds.—The consultant was impressed with the number of cases of wounds that appeared to have been self-inflicted. The majority of these were missile wounds often sustained, according to the history, while the individual was cleaning an M–1 rifle or carbine. A number were attributed to accidents in connection with squirrel shooting during furloughs. One case in particular, however, involved a soldier who used a hatchet to sever completely all four fingers of his left hand, requiring 11 strokes to complete the job (fig. 37). On the whole, it was extremely difficult to prove that many of these wounds were self-inflicted. It would seem, therefore, that the experiences of others should be correlated and the entire matter should receive extended study.

Reconditioning.—A well-coordinated plan for reconditioning patients in all of the Eighth Service Command hospitals was developed. This was due largely to the caliber of those in charge, to the provision of an adequate physical setting in nearly every instance, to close cooperation on the part of the surgeons, and to a general acceptance of the whole idea of the plan on the part of the patients. The following eight points concerning reconditioning appear worthy of special comment:

1. Too often there was a feeling on the part of medical officers that higher authorities were going to measure the success of their reconditioning unit by the actual number of patients who were admitted and retained; that is, by the size of the unit. Unquestionably, this, in some instances, resulted in an unnecessarily prolonged stay.

2. A misconception arose as to whether every patient, regardless of his condition or of the nature of his illness or accident, was to be sent through a formal reconditioning process rather than be discharged directly to duty.

3. Probably too much emphasis was placed upon the physical side of reconditioning at the expense of the mental and, especially, the spiritual side.

4. Directing a large reconditioning annex was one of the more important jobs in a hospital, and the position should have been made more attractive by setting it up on a par with the other major services and giving it commensurate rank.

5. Close proximity of the hospital proper to the reconditioning annex was a distinct drawback.

6. Standardized periods for rehabilitation were to be deprecated; instead, more individualization by ward officers was desirable.

7. For those convalescents who did well and who cooperated fully in the program, incentives, such as weekend passes, could have been furnished to advantage.

8. A healthful competitive attitude, properly supervised, was considered desirable.

To summarize, it was believed that the idea should have been constantly borne in mind that reconditioning was only a means to an end; that is, the return of the soldier to duty as soon, and in as good general condition, as was possible with safety to himself.

Rehabilitation.—It was felt that reconditioning as carried out in station and regional hospitals was more effective than was rehabilitation in general hospitals. The former hospitals were concerned with patients who, for the most part, were eventually going to return to duty, whereas the same was not true in the case of many of the oversea casualties which comprised the general hospitals' rehabilitation sections.

It was also felt that the proximity of the rehabilitation annex to the rest of the hospital—apparently unavoidable in the case of the general hospitals—was a distinct disadvantage.

There was a marked variation in interest in occupational therapy. Efforts to make this activity more practical and less diversional might have enhanced its value.

The same program of rehabilitation and reconditioning could not have been expected to function effectively under such basically different conditions as existed with respect to individuals returning to duty and those who were not. More attention should have been paid to providing for a well-organized program to bridge the gap between early convalescence and true vocational training.

Prisoners of war.—The care of patients in the prisoner-of-war hospitals was generally satisfactory and was noticeably so in Glennan General Hospital, Okmulgee, Okla., during the period that this installation served in that capacity. On the other hand, some of the smaller hospitals were handicapped by language difficulties and by an insufficient number of trained medical officers. In these, the surgical patient was not cared for so satisfactorily. It was necessary to make changes in the personnel in order to correct some of the situations that arose in the hospitals attached to some of the prisoner-of-war camps.

MEDICAL EDUCATION

The consultants in Eighth Service Command and especially the surgeon, Col. (later Brig. Gen.) W. Lee Hart, believed that the program for medical education was a most important phase of the consultant's work. Teaching, round table conferences, grand rounds, and informal presentations of special topics were among the measures adopted in connection with this program of medical education. In addition, through the generosity of the Rockefeller Foundation, and as a result of the efforts of the service command medical consultant, Col. Walter Bauer, MC, a fund was provided which enabled the service command to make three further contributions to the improvement of medical education. The first of these entailed visits of from 10 to 14 days' duration by outstanding civilian practitioners, many of whom were highly experienced in teaching. These visits embraced a group of station, regional, and general hospitals. The visitors and the consultant made rounds, examined patients, conducted round table conferences, and gave talks usually illustrated by lantern slides; they were available for informal conferences with the various members of the surgical staff. Among the surgeons who participated in this program were Dr. Philip D. Wilson, Dr. Robert L. Payne, Dr. Dallas B. Phemister (fig. 38), Dr. Sumner L. Koch (fig. 39), Dr. Frederick W. Bancroft, Dr. Warfield M. Firor, Dr. Peter Heinbecker, and Dr. Harold L. Foss. In addition, a distinguished pathologist, Dr. Fred W. Stewart, visited a number of the general hospitals where special emphasis was laid on the pathology of cancer and its histologic diagnosis.



FIGURE 38.—Dr. Dallas B. Phemister of Chicago and Col. Bradley L. Coley making rounds at the station hospital, Enid Air Force Station, Okla. (Dr. Phemister in civilian suit and Colonel Coley opposite him with left arm on patient's pillow.)

Another effective medium for teaching was the clinicopathologic conference, the expenses of which were assumed by the fund of the Rockefeller Foundation. As a result, each hospital received at regular intervals two cases, together with pertinent X-ray reproductions and microscopic section. These clinical abstracts and autopsy protocols were prepared from cases taken from the Massachusetts General Hospital material and were carefully selected for their interest and variety.

Furthermore, the fund made it possible to supply certain medical textbooks to some of the hospitals to augment the excellent libraries which were furnished directly through the Office of the Surgeon General.

It is believed that the expenditure of considerable time and effort on the various phases of this teaching program was fully justified by the results obtained. There is little doubt that these measures contributed to keeping alive in the medical officers the spark of clinical interest and enthusiasm which was somewhat dimmed at times by the nature of their assignments in the Army.

BRADLEY L. COLEY, M.D.



FIGURE 39.—Dr. Sumner L. Koch discusses a case of hand injury with medical officers at Camp Swift Station Hospital. (Dr. Koch in civilian suit with Colonel Coley immediately to his left.)

Section II. The Second Consultant, 1945[1]

An appraisal of the difficulties, the usefulness, the accomplishments, and possible improvements in the consultant system may be made from numerous points of view. The remarks which follow were written by a former medical officer, Col. Henry G. Hollenberg, MC, who served 4 years in the AUS (Army of the United States) during World War II, all within the continental United States. During the first 3 years of the war, Colonel Hollenberg was assigned as chief of surgical service in Bushnell General Hospital, Brigham City, Utah. During the last year of the war, he was surgical consultant of the Eighth Service Command. His remarks were set down some 11 years afterward and without notes, so that only general impressions and outstanding events were recorded. These impressions were based upon three general areas of experience

[1] Col. Henry G. Hollenberg, MC, succeeded Col. Bradley L. Coley, MC, as surgical consultant in the Eighth Service Command during the last year of the war. Rather than write a factual account of his activities as a consultant, he has chosen to give his views on the consultant system in general. His comments are pertinent, understanding, and most interesting.—EDITOR.

In the first area were those impressions obtained while he was not a member of the consultant team but observed it from the outside, so to speak, as chief of service in a general hospital. This was a period during which the Army was being built to its maximum size and effectiveness, and the general morale was high. The second period was the final year when Colonel Hollenberg was, himself, a consultant. During this time it was obvious that the general conduct of the war was coming to a successful conclusion. The buildup was entirely over, and enthusiasm for the Army was decreasing and, finally, was extremely low. The period of demobilization occurred at the end of this year. While it cannot be said that morale was low, certainly interest in the Army was almost nonexistent and everyone was anxious to return to civilian life. The third period is that since the war when this writer has observed in a general way the utilization of consultants during peacetime and in the oversea armies of occupation.

THE CONSULTANT SYSTEM

Until World War II, the Medical Department of the U.S. Army did not recognize or encourage much specialization among its medical officers. The fields of ophthalmology, otolaryngology, and certain forms of surgery constituted exceptions to this general situation. A doctor was a doctor and could be put to work doing surgery or medicine or whatnot. This was the attitude also in civilian medicine to a large degree. But at the outset of World War II and with the great mobilization which was under way, it was recognized that the advantages of specialized work, so clearly apparent and prevailing in civilian medicine, should also be utilized in the Army. The decision to utilize specialization was obviously made at high levels of authority. Many changes were made to accomplish this end and to improve the effectiveness of the Medical Department in general.

Among certain innovations was a widespread system of consultants. The men so assigned were physicians recruited almost exclusively from civilian ranks. An attempt was made to procure men a little older and more experienced than the average and, ideally, men with some national standing. From the beginning, they were made to understand the overall plans and pitfalls involved in the program and were assigned to headquarters of service commands, field armies, and so forth. It was the duty of these consultants to make periodic visits throughout the command or theater to see that professional work was actually set up and operated according to a well-thought-out plan, to see that men were properly assigned and utilized, and to insure that proper procedures were being carried out in accordance with good general medical practices and in accordance with every changing Army order. It was their further duty to work closely with higher authority and to act as liaison and coordinating officers between the headquarters of the command to which they were assigned and the various hospitals.

GENERAL CONSIDERATIONS

Relations between medical officers of the USA and those of the AUS.—One needs to recall that at the very beginning of mobilization in World War II there was a small group of regular medical officers well trained in the operations of the Army Medical Department. Practically all of the vast number of new medical officers were completely unfamiliar with the manner in which the Army and the Medical Department operated. A small number of the older men called to service in World War II had seen service in World War I. This situation may not obtain to a similar degree henceforth when many young physicians will have served previously. These regulars were, in all cases, men familiar with Army regulations, accustomed to command and to obey, and, in many but not all cases, quite proficient in the care of sick and wounded. The new medical officers were all recruited and commissioned as temporary wartime officers in the AUS. Many were commissioned in field grades and were mainly without one day of training as soldiers. They brought to the Army a vast amount of patriotic enthusiasm, a high grade of professional ability and attainment, and fine fellowship; but they had no awe of rank and, occasionally, even showed disrespect for some phases of Army manners and customs.

The author has on the whole great respect for the understanding and tolerance on the part of most of the Regular Army officers in this situation. But there were those among them who took a harsher position toward these new men because of their clumsiness with strictly Army matters, on account of the rapid attainment of their rank, and for other reasons. This situation furnished fertile ground for unhappiness and stubborn resentment all around. Likewise, nearly all the newly recruited personnel realized that there were reasons for Army regulations and forced themselves to adapt promptly. In fact, some attempted this so completely as to make themselves almost comical. But there were others who took the unjustifiable attitude that soldiering was a Boy Scout affair to be resisted.

Another point of tension existed between officers of the Regular Army and those of the AUS pertaining strictly to professional matters. There was no question but that the new officers brought to the Army a higher overall professional skill than had existed before. Due consideration immediately needs to be given to certain regular officers who had high peacetime reputations and ability in the field of amputations, tuberculosis, certain infections, and so forth. But, on the whole, the proposition stated above would have to be accepted. As a result of this condition, awkward situations arose. The most serious was that a regular officer of high rank in administrative or command authority could dictate by his influence or order professional treatment which the AUS officer knew to be outmoded or less effective than some other form of treatment. This not only resulted immediately in less effective treatment but completely undermined confidence in these commanders. Most often, such orders were circumvented or disobeyed causing the responsible officer to

feel frustrated and resentful toward his subordinates. This is not to say by any means that the professional thoughts and suggestions of such regular officers should not have been made or should not have been considered or were not in many cases quite helpful. Quite the reverse was true. In the matter of early ambulation, for instance, it was largely the members of the Regular Army who put forth this idea which was finally generally accepted. But, on the whole, it was eventually necessary to create a situation wherein the regular officers had their province of complete administrative and command authority (where certainly they only were thoroughly capable) and wherein the AUS officers had more or less complete domain over the care of the sick and wounded. This happy solution came about in no small part through the activities and influence of the consultants and, of course, by the spirit of cooperation and the good will of all concerned.

Relations between the Medical Department and other branches of the Army.—Another area of tension existed occasionally between certain line officers and the Medical Department personnel associated with them. Actually, officers of the line and all Army personnel, including post and army commanders, had respect, great friendliness, and even affection for the Medical Department, which was so useful to them in time of need. But, during any rugged period, the Medical Department could be visualized as a softer berth. Commanders might have felt that unreasonable demands were made by the Medical Department as regards supplies, personnel, and so forth. As a result, line commanders of high rank might have seriously interfered with the program of the Medical Department. Their action usually did not concern the medical officers of the AUS but involved a dispute between brother officers of the Regular Army. In all these encounters the Medical Department, without outside help, frequently came off second best because of their lesser rank and because they exercised no command outside the Medical Department. This resulted, again, in a feeling of resentment on the part of hospital commanders, for instance. To do justice, however, it needs to be pointed out at once that, here again, a post commander, for example, might often have been right and have been acting with information not generally held. The consultant frequently and suddenly found himself in the middle of a problem of this sort on the occasion of a routine visit. It might be pointed out that the consultant at the time of each visit to a post first visited the post headquarters and made himself available for a conversation with the post commander. And this occurred likewise at the time of his departing from the post. In all cases in the author's experience consultants were warmly received and cordially regarded. They were recognized as individuals visiting various camps and in touch with high authority. Problems of all sorts could be brought up and freely discussed. In many of these instances, the consultant, using a good deal of tact and diplomacy, could intercede very successfully and bring about a solution to local problems by his own efforts. In other instances, the matter

could be properly taken to a higher authority much more quickly and informally than through other Army channels.

Personnel problems.—The problems which could arise concerning personnel were legion. This might have been more pronounced among medical officers than among any others. There were personality conflicts between individual officers of the AUS, great unhappiness as to assignment, violent conflicts as to professional ideas between officers of the same grade or of different grades (officers of the AUS really had little awe of rank, though they all earnestly sought higher rank), and strongly felt differences between chiefs of services and hospital commanders. In all of the problems, and possibly here best of all, the consultant was helpful. Everyone concerned could talk to the consultant with confidence in the fact that he was having an interested and unbiased hearing which was entirely off the record, if necessary. The consultant had a better overall picture as a rule than anyone at an individual post and, in almost all instances, could offer helpful advice or a downright solution to local problems. The acceptance of his opinions was amazing. Yet, in this connection, it might be brought out that in the last analysis he had no direct authority. His influence was more like that of one physician among others in civilian practice. The only real authority could be obtained by requesting specific action through the service command surgeon, and service command personnel officer, and so forth.

PROFESSIONAL MATTERS

Stimulation provided by consultants.—In strictly professional matters, every honest physician needs and desires consultation frequently. Groups working within a hospital or any medical organization soon became familiar with each individual's thinking and need for stimulation of new ideas and new personalities. The consultants furnished this stimulation admirably and in direct proportion to their individual personality and professional attainment. In the Eighth Service Command during World War II, a rather successful and unique plan of utilizing civilian consultants was in effect. With funds generously donated by the Rockefeller Foundation it was possible to invite an older and usually distinguished civilian physician to accompany a military consultant of like specialty during his rounds of a number of hospitals and usually over a period of a week or two. The funds were sufficient to pay the expenses of this civilian and to furnish a small honorarium. The professional stimulation furnished by this additional consultant was profound. Their visits were of interest to nonmedical personnel. And these civilian physicians themselves greatly appreciated the chance to be of service and the opportunity to see so intimately the workings of the Army. They were unanimous in expressing their appreciation after each visit. The favorable effects of this sort of plan were obtained, the author would imagine, through the system of utilizing different civilian consultants from month to month in the oversea armies of occupation after the war. It was certainly a good plan as far as strictly

professional matters were concerned; the usefulness of such civilian consultants was limited in certain respects inasmuch as they were not members of the Military Establishment.

Policing of hospitals and services.—As regards policing of hospitals and services, the consultants fulfilled a highly useful, though to them disagreeable, service. The different sizes and types of hospitals were nicely organized and equipped with the personnel to do varying degrees of professional work. Furthermore, certain general hospitals are set up as centers for such interesting disorders as arteriovenous aneurysms and other vascular conditions, plastic procedures, and so forth. And, for very good reasons, it was highly desirable that specialized work of certain exceptional sorts be done in a special place by highly qualified specialists. But, physicians are a queer lot in such matters. Confidence or overconfidence, boredom or great professional pride and interest influenced medical officers in many cases to overlook orders which limited their work to certain types of cases and caused them not to refer proper cases to the specialized centers. Under the worst circumstances, the hospital commander himself might have been unsympathetic with any referral plans; he might have had such pride in his hospital and such confidence in his medical officers that he did not require them to follow orders to refer particular cases. He might not have permitted them to do so.

Although it must be admitted that some major and specialty work was well done in smaller hospitals and smaller groups, the reverse was too frequently true. This writer has seen common duct injuries in simple cases where the patient should have been referred according to orders to another hospital where thoroughly capable surgeons were in waiting. In their routine rounds, consultants were alert to this situation of medical officers wanting to do more than they were permitted to do. Monthly checkups at headquarters on all deaths furnished clues in these unfortunate cases not properly referred. In fact, the system of consultants was a deterrent to these errors' happening at all because, in the first place, the consultant could make the regulations clear and, in the second place, it was known that there was some system of check. In practice, however, the search in hospitals for such cases, which were usually well hidden away, constituted something of a game. The stakes were high, the rules were changed too often, and the penalties were ill-defined for the offender. For the innocent victim, the penalty was often clear cut.

Relations with the Army Air Forces.—This writer, while a consultant, also visited hospitals of the Army Air Forces, as was customary in the Eighth Service Command. Certain well-recognized difficulties between the medical service of the Army Air Forces and the rest of the Army were never apparent on any such visit. The cordiality and cooperation even exceeded that at the hospitals with which this consultant was more directly connected. For instance, on one occasion the service command surgical consultant, accompanied by a civilian consultant, found insurmountable difficulties for convenient travel by air or otherwise between Santa Fe, N. Mex., and Amarillo, Tex. The result

was a bus ride. When the general commanding the Air Force base at Amarillo heard of this, his assumed air of wrath was considerable and his directions to telephone on the next occasion for a plane were quite explicit. From his viewpoint, he had hundreds of aircraft flying about on mock assignments for training. It would have been a proper mission for one of his officers to fetch a consultant on orders to visit the base. Certainly his offer was accepted on the next occasion, but, to have asked for such a service without such an invitation might well have been considered presumptuous.

On all visits made by this consultant to these Air Force hospitals, suggestions and criticism, while given more guardedly, were well received and acted upon. On a professional basis, visits seemed to be received with even more enthusiasm. Everyone apparently recognized that there were some differences at higher levels and beyond the control of those concerned at the local level. Relations with other consultants of the Air Forces were, of course, cordial in the extreme for the reason that they were in many cases good friends and all civilians in uniform trying to do a good job with the armed services. It would seem that in later years and with changing conditions there will still need to be different groups of consultants for various branches of the service for the reason that some of the overall problems differ widely in the various branches. At the same time, much of the work could be unified.

The life of a consultant.—The life of a consultant is usually active and interesting, though, in some respects, rather trying and out of keeping with that of a doctor in the usual sense. A consultant's duties are perhaps 25 percent of a clinical sort regarding patients, and that rather strictly in the true sense of a consultant. A surgical consultant, for instance, rarely operates. This is a situation which may cause a strange void in his heart. There is a vast amount of tiring travel, in hot or cold weather, and a great amount of small chatter and social amenity. Although the latter duties may at times be pleasant and at times boring, they are always important and it is in such conversations that goodwill between various factions may be brought about. The making of routine reports is troublesome but not arduous. Decisions as to personnel problems may be difficult or heart-rending. The individual consultant works out his own most effective way of going about his business. Some utilize an austere and firm manner. As a rule, the kindly, gloved approach—always fair and thorough—is most appreciated and effective. For these various reasons, consultants in specialized fields of medicine need, of course, to be true specialists in that category. But the work so largely concerns overall problems that the men need to be broad. Orders as to their conduct and duties can be given only in general terms as the situations are always different. Judgment and freedom of action are required and must be exercised properly. For these reasons, a man in any specialty can act as a consultant in many respects. For the same reason that general surgeons are usually the directors of surgical departments in schools and that general internists are directors of medical departments, it is usual that these two categories head up the two main groups of consultants.

The Army has such a vast volume of work in the fields of psychiatry and orthopedics that the men in these departments are in some respects more helpful in a clinical way than any others.

The ideal consultant.—An ideal consultant needs to be a bit older man, thoroughly trained and capable in his specialty. He needs to be articulate, tactful, and socially agreeable. Certainly he needs good judgment in routine and in unexpected situations. He should be either forceful or persuasive. He should be interested, to some degree, in teaching and should be sympathetic with personnel problems in various categories of personnel. A degree of modesty after considerable unaccustomed attention is a great asset. He should not be downcast when overruled. One with a strong stomach and good bowels will go far.

THE FUTURE OF THE CONSULTANT SYSTEM

It would be useless in many respects for this writer to attempt to predict the need for this system in the future. Yet, many of the problems discussed are present in an army of any size and under any conditions. In the event of any large mobilization again, the same problems will recur. Fairminded men with a broad vision and with a wide acquaintance with men in American medicine can again head up such a consultant system and, with proper modifications, again put it into good use.

HENRY G. HOLLENBERG, M.D.

Section III. The Orthopedic Consultant

During the latter half of 1940 and the entire year of 1941, the physicians, both civilian and military, in the induction stations were, for the most part, not sufficiently acquainted with or oriented in the military standards of physical fitness and allowed many men with musculoskeletal disabilities to be taken into the Army. The endeavor which was made to qualify these inductees for general military service was not too successful and will be explained in detail later. In 1942 and thereafter, training and combat injuries added greatly to the caseload of orthopedic conditions which, with a corresponding increase of other surgical conditions, made it impossible for the service command consultant in general surgery to supervise the entire surgical part of the medical situation. Hence, there came into being the orthopedic consultant, Col. Thomas L. Waring, MC.

DUTIES AND FUNCTIONS

The administrative and professional duties of the orthopedic consultant paralleled those of the surgical consultant. Among the many duties of the orthopedic consultant was the evaluation of the competence of the medical personnel assigned to the orthopedic service. When deficiencies were found, their correction usually required a shift of personnel. This often could be accom-

have been affected. When this rule was observed, the value of the consultant's visit was enhanced.

PROBLEMS WITH PHYSICALLY UNQUALIFIED INDUCTEES

It was frequently noted in the evaluation of an orthopedic service that the orthopedic surgeon did not exercise sufficient care in the selection of cases for operation; for example, a patient was operated upon without sufficient regard for the probable outcome insofar as returning him to combat duty was concerned. This error in operative indication was no doubt due to the fact that the orthopedic surgeon in question was not fully indoctrinated into military medicine. The most glaring examples that could be cited were in those conditions that had been incurred prior to induction. By civilian standards, these operations were justified; however, by military standards, the reverse was true. Most frequently, these operations were for the following orthopedic conditions: Internal derangement of the knee, recurrent dislocation of the shoulder, congenital deformities, fracture deformities, ruptured disk, and bunions. Rarely was a patient returned to general duty after an operation for such a condition incurred before induction; a few were assigned to limited duty; but the majority of the patients received a certificate of disability discharge. The orthopedic surgeons in the command soon learned that, even when the aforementioned conditions were incurred in line of duty, great care in evaluating the personality and psychogenic background of the patient was necessary before giving an absolutely valid indication for operation. This experience taught all that great care should be exercised in evaluating the patient, and that, frequently, operation should be withheld.

Many of the directives limiting the type of operation for elective conditions permitted in a station hospital did not concern the orthopedic surgeon, for in the majority of the station hospitals no trained orthopedic surgeon was assigned. The surgical service was habitually covered by a general surgeon who usually did not have much interest in orthopedic surgery and was glad to be relieved of it.

It became quite evident that better methods and more careful orthopedic examinations were necessary in order to weed out inductees with disabling orthopedic conditions. The large number of men inducted with such disabilities certainly attested to the deficiencies in the method of screening inductees. The mistakes were due to (1) inexperience of the civilian physician or of the examining medical officer in military medicine, with failure to realize the significance of the danger of minimizing or overlooking defects, (2) too few medical personnel to handle the number of inductees examined, and (3) too little attention given to the inductee's statement on his disability.

It was well known that certain orthopedic conditions could only be diagnosed by an adequate history in a period of quiescence; for example, a knee with a torn semilunar cartilage might have shown no physical evidence of this condition when the torn portion of the cartilage had been temporarily replaced.

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Similarly, a recurrent dislocation of the shoulder would have shown no physical finding except when it was dislocated. Too often, an attitude was taken by the examining medical officer that the inductee was trying to keep out of the military service, with the result that he was inducted with a disability which made him useless to the military, and his ultimate fate was a certificate of disability discharge in due course of time with much inconvenience to the Government and needless expenditure of public funds. These deficiencies were overcome by staffing induction stations with adequate medical personnel specially trained to recognize these conditions and by taking a more realistic attitude toward the medical statements of the examinee.

SPECIAL ORTHOPEDIC PROBLEMS

Many musculoskeletal problems were encountered which required special consideration. A discussion of some of these problems considered worthy of note follows.

Compound fractures.—In the early days of the war, it was most difficult to convince orthopedic and other surgeons treating compound fractures that in military surgery the use of internal fixation and primary closure was a dangerous procedure and should not be followed. Later, a directive from the Office of the Surgeon General prohibited the practice of internal fixation and closure.

March fractures (fatigue fracture, insufficiency fracture).—March fractures, especially of the metatarsals, presented a major problem in infantry training centers. The disability resulting from this condition interfered with the continuation of basic training. In the beginning, trainees with this condition were hospitalized and the extremity was placed in a short leg plaster cast with a walking bar. The average period of disability was from 6 to 12 weeks. It was soon realized that, although this was a painful condition, it was not serious. A method of treatment devised at Camp Wolters, Tex., and used successfully in the Eighth Service Command, did not require hospitalization and allowed continuation of training, excepting only forced marches. Treatment consisted simply of a rigid steel shank in the shoe which prevented flexion of the foot at the metatarsophalangeal joints. March fractures of the metatarsals were the only type of fracture in this classification that could be treated on an ambulatory basis. Fatigue fractures of the major bones of the extremities and pelvis required hospitalization.

So-called sprained wrist.—Undoubtedly, the majority of injuries to the wrist from falls resulted in simple sprains, but, from bitter experience, it was found that a certain percentage of the so-called sprained wrists actually were fractures of the carpal navicular bone. When this condition was allowed to prevail for a long period of time, severe disability resulted. In order to detect the fracture, it was determined that all injuries to the wrist should be X-rayed in four planes—anterior-posterior, lateral, right and left oblique. Initially,

these views may have shown no fracture; however, the injury had to be treated as a fracture until proved otherwise by a similar set of X-rays 2 weeks later.

Ankle fractures.—Many poor results were noted following bimalleolar and trimalleolar fractures of the ankle when the fractures were not reduced anatomically. Minor fractures could usually be satisfactorily reduced by manipulation with anatomic replacement of all elements, especially those involving only the medial malleolus, but all other types of ankle fractures should have been reduced by open operation.

The painful low back.—This condition was very common in all service commands, and only the experienced surgeon could differentiate between the legitimate and the feigned. Consequently, it was common knowledge that this condition was difficult to evaluate, and outpatient physical therapy clinics were overburdened with these patients. However, as a more thorough understanding of this condition was gained, and as consultation with the neuropsychiatrist became more frequent, complaints of low back pain decreased appreciably.

Self-inflicted wounds.—The majority of self-inflicted wounds, especially those of the feet and hands, were incurred while the soldier was on furlough. In a significant number of cases, the opposite lower or upper extremity from the handedness of the soldier was injured. These cases always presented a very delicate situation as to line of duty.

Hand injuries and infections.—In the early stages of the war, treatment of hand injuries and infections was so haphazard that headquarters of the Eighth Service Command sent out corrective directives to all medical treatment facilities. One of these bulletins directed that all hand injuries and infections should be handled by the section with the most experienced surgeon in this field, regardless of whether he was a general surgeon or an orthopedic surgeon.

SPECIAL CENTERS AND REHABILITATION

The establishment of special treatment centers was a definite step forward in providing better care for the soldier. This was especially true with regard to the hand, neurosurgical, and paraplegic centers, which required highly specialized personnel in scarce categories.

The hand centers, with Dr. Sterling Bunnell as the chief consultant, contributed much to the knowledge of hand injuries. Information and indication of treatment of these injuries were disseminated widely and a decided improvement was reflected in the care of hand cases. Many outstanding surgeons of postwar days have received their training in these centers and have continued to contribute to the knowledge of hand surgery.

The rehabilitation program as established in the hospitals, rehabilitation centers, and annexes to the various treatment centers did much to lessen the convalescence period. It was the consensus that the rehabilitation centers located at a distance from the hospital were more effective because, at times, patients were retained in the center longer than was necessary, especially in those rehabilitation activities connected with the named general hospitals. It

was realized, however, that the program in connection with a general hospital differed in certain respects from that in a regional hospital. In the latter, a greater number of patients were expected to return to duty. The reconditioning program was a very important part of the treatment.

MEDICAL EDUCATION

It is the impression of this author that every physician is better off professionally for having spent some time in the military service. There may be exceptions to this statement, but they should be relatively few. The medical officer had an opportunity to associate with other medical officers, ranging from general practitioners to the highly specialized, from all parts of the country. In most hospitals, the educational program was excellent and was keyed to the dissemination of medical knowledge useful to all concerned. The specialist with practice and association narrowed to a very limited field found out what was going on in fields other than his own. The consultant system contributed much to the dissemination of medical knowledge.

Libraries in most fixed establishments were equipped fairly adequately, with the exception of reference files. This defect was overcome to a certain extent by the excellent photostatic reproductions obtainable from the library of The Surgeon General.

In the Eighth Service Command, through the efforts of Colonel Bauer, additional educational advantages were obtained through the Rockefeller Foundation; for example, the purchase of medical books, periodicals, and clinical pathological material and visits of outstanding physicians and surgeons. Arrangements were made with these specialists to spend a prescribed period of time in the service command, visiting the various medical facilities with the service command consultant. It was impossible for such a specialist to visit all facilities. Consequently, in order that full advantage could be taken of his teaching, the institution so favored would invite interested medical officers of neighboring institutions to be present. Full cooperation was obtained in this by service command headquarters and other facilities involved. The visiting specialist and the consultant made rounds, examined patients, conducted round-table conferences, gave formal talks, and, generally, were available to all concerned literally 24 hours of the day.

The orthopedic surgeons participating in this program were Dr. Arthur Steindler, Dr. Marius N. Smith-Petersen, Dr. Ralph K. Ghormley, Dr. J. Albert Key, Dr. J. Spencer Speed, Dr. William W. Plummer, and others.

COMMENT

The writer wishes to comment, not through a sense of duty but because of the very sincere belief, that the primary concern of the Eighth Service Command surgeon, Colonel Hart, was to see that every soldier received the best

medical care possible. No shortcuts were tolerated; rank did not enter into the picture. The most capable medical officers were assigned to positions of responsibility, regardless of rank. That this policy created very little animosity was really surprising and, in the opinion of the writer, was due to the most hearty cooperation of all echelons of the medical service of the Eighth Service Command.

THOMAS L. WARING, M.D.

CHAPTER XIV

Ninth Service Command

John J. Loutzenheiser, M.D.

ASSIGNMENT AND ORIENTATION OF ORTHOPEDIC CONSULTANT

It was not until December 1943 that an orthopedic consultant was appointed in the Ninth Service Command. This consultant was Col. John J. Loutzenheiser, MC, who had entered military service more than a year earlier. His prior service as chief of orthopedics in a general hospital proved to be useful and had allowed him to obtain full knowledge of many of the problems that concerned an orthopedic section in a general hospital. With such a background, a consultant had more sympathy with the multiple difficulties which existed on the home ground of the various hospitals in his command.

On reporting to the Ninth Service Command headquarters at Fort Douglas, Utah, the new orthopedic consultant was briefed on his duties by Col. John B. Flick, MC, Consultant in Surgery, before reporting to Brig. Gen. John M. Willis, who was surgeon of the command. Colonel Loutzenheiser's introduction to the consultant group with which he was to work was an important moment in his military service. As he recalls it, General Willis said: "We have a great medical team here, and we will insist that you be a team player." It did not take long for Colonel Loutzenheiser to realize that this command had taken a group of brilliant individualistic doctors and had welded them into an efficient consultant team for military medical purposes. Col. Verne R. Mason, MC, Col. Lauren H. Smith, MC, and Colonel Flick were the medical, psychiatric, and surgical consultants. These consultants gave Colonel Loutzenheiser a few words of advice which should be noted here because undoubtedly this advice helped him in his relationship with hospital commanders as well as with his fellow orthopedic surgeons in service. They stated: "We make an effort to work harder than anyone else in the hospital we are inspecting and you must do likewise if you expect to gain the respect of your confreres, be helpful before you are critical, study the commander's personality as well as his personnel, and report only accurate, factual, existing circumstances."

AREA AND MEDICAL TREATMENT FACILITIES

The geographic area of the Ninth Service Command was comprised of the eight Western States of Montana, Idaho, Washington, Oregon, Nevada, Utah, California, and Arizona. This area contained 12 general hospitals, 11 of which were located in the coastal States of California, Oregon, and Wash-

ington, and the other in the State of Utah. There were in California two regional hospitals at Oakland and Pasadena and large station hospitals at Fort Ord, Camp Roberts, Camp Haan, and Camp Stoneman. In addition, there were large station hospitals at Fort Lewis, Wash., and at Fort Huachuca, Ariz. There were other hospitals to be visited, such as those of the ports of embarkation at Seattle and San Francisco and the prison camp hospital at Phoenix, Ariz. Air Force hospitals were occasionally visited when the need was indicated. When one considers the great distances which had to be covered in the Ninth Service Command and the number of hospitals to be inspected, it is evident that the consultant spent almost as much time traveling as he did in actual work.

In order to design a practical plan for inspecting this command, the area was divided into four sections: Northwest (Washington and Oregon); northern California and Nevada; southern California and Arizona; intermountain—Idaho and Montana, where there were no general hospitals; and Utah, where the service command headquarters and amputation center were located. Ideally, one needed a 3-day stay in a large general hospital to accomplish the optimum good, but, often, no more than 1 or 2 days could be spent because of the time required to cover the service command. A consultant should not have been absent from his headquarters for more than 2 weeks. That length of time allowed one to visit from four to six hospitals on each inspection trip. In an area as large as the Ninth Service Command, it might have been better if a regional consultant system had been set up which would have allowed all the station hospitals within a given area to come under the consultation of a top orthopedic surgeon from a nearby general hospital. Such a plan should have worked well and improved the care of patients in the smaller hospitals. Unfortunately, it was difficult to divide responsibility or delegate authority when one was personally responsible to the surgeon of a command. As it was, the mission of the orthopedic consultant would never have been accomplished, and the job could never have been done, had it not been for the extraordinary efficiency and cooperation of the Surgical Consultants Division in the Office of the Surgeon General, the service command surgeon, and fellow service command consultants. It can be stated also that the chiefs of orthopedic surgery in the general hospitals of the Ninth Service Command were highly competent surgeons who made the work of the orthopedic consultant much more a pleasure than an irksome duty.

ORTHOPEDISTS IN THE COMMAND

Outstanding Orthopedic Surgeons

A list of the orthopedic surgeons who did fine work in the Ninth Service Command would necessarily be long, but they must be named. Many of them not only carried on their regular duties, but also assisted the orthopedic consultant in establishing teaching centers for the training of surgeons in certain

limited phases of orthopedic surgery. These officers are not identified with a particular hospital because they often served in more than one. Where possible, the chiefs of orthopedic surgery are listed with their assistants, as they worked as a joint team. In all instances, however, the chief of service was responsible for the high character of the work, loyalty, and enthusiasm of his assistants, Lt. Col. Ernest E. Myers, MC, and Maj. Harold W. Woughter, MC, Lt. Col. Richard B. McGovney, MC, and Capt. Mario F. Tagliagambe, MC, Maj. Carroll O. Adams, MC, and Capt. A. Luckey, Lt. Col. Edward K. Prigge, MC, and Capt. Frederic W. Rhinelander, MC, Maj. Thomas H. G. Aitken, SnC, and Capt. Alvin J. Ingram, MC, Maj. Robert F. Warren, MC, and Capt. Robert B. Portis, MC, Maj. George E. Waters, MC, Maj. Norman R. Brown, MC, Capt. Harold Unger, MC, Maj. Robert H. Denham, MC, and Capt. Walter Carpenter, MC, Maj. (later Lt. Col.) Maurice M. Pike, MC, and Capt. Donald R. Pratt, MC, Maj. Donald B. Slocum, MC, and Capt. (later Maj.) Donald E. Moore, MC, and Maj. Robert King, and Capt. Joel Hartley, MC. These were the men who made a great contribution to orthopedic surgery in the Ninth Service Command. There were others who played an almost equal part in this command but did more important things elsewhere. Undoubtedly, the latter will be listed for their accomplishments in the reports of other consultants.

Relationship of Consultant With Orthopedists

The relationship of the consultant with the orthopedists in the various hospitals was one of mutual respect. Open criticism of procedures was never made except in private. Ward rounds were a procedure for observation, information, and note taking for later critical survey. Criticism of care in the presence of patients was prohibited, but useful discussion was allowed. Orders from higher authority were enforced by the consultant, but he never tried to force a confrere to his opinion. There were times when criticism was better accomplished by asking for a written review of patient care when some particular procedure was in question. This procedure may have been a favorite of the orthopedist on duty, and one that was not in full accord with overall surgical policy. After he had made a review of his patient care he often came to the proper decision without any comment from the consultant. Another approach to the problem of getting an orthopedist to change his ways was to discuss the success that some other hospital was having with an approved procedure. If these methods failed, one gained cooperation either by bringing an important orthopedic civilian consultant on hospital rounds to criticize, while making valuable suggestions, or by bringing another capable orthopedic officer in to work alongside the recalcitrant chief of section. Soon the competitive effort of fine work would improve the entire orthopedic service. It was necessary to have a personnel officer in the headquarters of the service command who was willing to work with the consultant in order to accomplish these ends. Forcing a chief of section to agree with the consultant, going over his head to the hospital commander, or undermining him with his chief of

surgery were not proper or effective methods. If the surgeon was competent but stubborn, there were better ways of handling the situation. On the other hand, if he refused to be cooperative, it was advisable to move him immediately. Rarely was there a surgeon who did not have some real value. A man who was considered to be incompetent in one job might prove to be competent in another. The consultant was obligated to find a proper place for each man.

RELATIONSHIP OF CONSULTANT WITH HOSPITAL COMMANDERS

It took the consultant a little time to realize that others had problems as well as he. It took time for a hospital commander to develop an adequate organization, and, once it was obtained, any commander was understandably unwilling to have the organization disrupted. In the movement of personnel, it was necessary to replace able officers with officers equally able, thus maintaining harmony with efficiency. To attain this harmony and efficiency, the consultant was advised to make an effort to establish understanding with the command officers of the hospitals. Where this was possible, it always led to mutual benefit. Occasionally, when the commanding officer of a hospital was desirous of having some change made in his orthopedic service, the consultant was able to meet his desires and better his service. At the same time, such changes made it possible to improve orthopedic service elsewhere which could make better use of the medical officer subject to transfer. Colonel Loutzenheiser did not desire to be considered overly politic during his inspection trips. Notwithstanding, he considered it a duty as well as a privilege to know commanding officers well. There were a few commanding officers who considered the consultant system a nuisance, but most of them appreciated its usefulness.

It was recognized that few of the general hospitals had adequate orthopedic facilities. Most hospitals were built on a 1918 plan, with a plaster room not much larger than a clothes closet and without adequate X-ray equipment nearby. There were no braceshops of any importance. Orthopedic departments were overloaded with inpatient and outpatient consultations. Patients waited for the operating schedules to provide time and space sufficient for their care. Consequently, the first reports sent in by the new consultant were extremely critical—not of the hospitals themselves, but of the facilities which they offered. Many hospital commanders were offended by such surveys and considered the consultant's report incorrect and unjust.

On arriving back at headquarters, the consultant soon sensed that he was just about as unpopular there as he was in the field. It was presumed that some of the indorsements on his reports suggested that the orthopedic consultant was attempting to force the hospitals commanders to request improvements and additional facilities which they did not believe necessary, on the basis that a good commander gets along with what he has and does the best he can with it. Fortunately, at about that time, The Surgeon General established a precedent for adequate orthopedic facilities, and clarification through his office allowed all improvements to be made which did not require new construction.

The Ninth Service Command immediately provided adequate orthopedic facilities in all its hospitals.

Suggestions resulting from this conflict in opinion as to the adequacy of orthopedic facilities included the following: (1) That a consultant in the Medical Department should have rank commensurate with his position, (2) that planning for improved facilities in all hospitals for specialized care was needed, (3) that the sick and injured should have the best facilities available and have them when needed, not months later, and (4) that the orthopedic consultants should be briefed in the Office of the Surgeon General before reporting to their assignments and twice a year thereafter, if possible.

It should be stated that this consultant rarely found it satisfactory to deal entirely with the executive officer of a hospital. The commanding officer who considered it more efficient to have his executive officer deal entirely with a consultant never reached the degree of rapport necessary for the proper coordination of his hospital activities with the service command or with the Office of the Surgeon General.

EARLY INNOVATIONS AND IMPROVEMENTS

Orthopedic Consultation in Hospitals

In the face of heavy workloads, it became necessary to solve the problem of providing inpatient and outpatient orthopedic consultation for the other hospital services. It was noted that patients were being referred for consultation from all sections of a hospital for trivial reasons; that is, nondisabling back ailments and shoulder, knee, and hip complaints for which orthopedic consultation was believed to be necessary. With the consent of the commanding officers of the hospitals, courses were established for training medical officers on other services in basic orthopedic examination. The routine examination of the feet, back, and other joints was not outside the province of any medical officer. After the development of these teaching courses, the consultation load dropped off markedly, and the valuable time of the orthopedic surgeons was released for longer periods in surgery. Concurrently, the younger medical officers were grateful for the more adequate knowledge they had gained.

Screening and Grading Patients for Surgery

As the consultant became familiar with his job, he soon realized that the remote wards of the hospital often contained large numbers of patients awaiting surgery. As capacity loads appeared, he found the most needed surgery being well done, but patients with chronic surgical conditions were waiting too long for their operations. As a result of this finding, the consultant reversed his ward rounds and from then on started with the convalescent wards and worked up through the hospital to the acute wards. This resulted in a different system of orthopedic care. With more exacting criteria for screening

and grading patients, the chronic bone and joint infections were moved into acute wards and took their place on the daily surgical schedule. In order to accomplish this with only a few orthopedic surgeons, it was necessary to train junior medical officers with surgical background in limited surgical procedures. The technique of careful cleanup of chronic bone infections, secondary closures, and split-skin grafting allowed a better production line in the surgical pavilion.

Some of the hospitals were staffed with medical officers who were much more capable of teaching than officers in other hospitals and consequently were selected as teaching centers. As young surgeons were assigned to the Ninth Service Command, they were further assigned to these teaching centers for later distribution overseas or into the hospitals of greatest needs. Such maneuvering demanded complete cooperation between the personnel officer and the surgical consultant.

Under the new system of ward arrangement with regard to the patient's condition, the number of wards designated as convalescent decreased. When a patient reached a convalescent ward in the new system, he knew that he was on his way to recovery. The descriptive terms "acute," "subacute," and "chronic" with respect to wards were discontinued, and the terms "active surgical," "continuing surgical," and "convalescent" were used in their place. On acceptance of this classification, the number of patients available for transfer to special surgical-reconstruction centers increased, and the number of convalescent bedpatients decreased. Further benefit was derived by getting these patients to the special centers with their chronic bone infections cleaned up and the skin closed, thereby reducing the workload in the special centers and allowing them to move ahead with their particular type of reconstructive surgery. Before the establishment of this system of care, when the patient was recognized to have a combined bone, nerve, and skin lesion, he might have been wrapped up in plaster and shipped out with his chronic infection only to sit in the special center and await care first by the orthopedic section, then by the plastic section, and finally by the neurosurgical section. This led to the overloading of special centers, with consequent delay in elective surgery, and with the production of surgical backlogs. Acceptance by orthopedic sections of their full responsibility in the care of chronically infected bone and joint lesions before transfer to special centers overcame this problem.

Diagnostic Screening in Unit Dispensaries

In the Ninth Service Command, the orthopedic consultant had infrequent contact with line officers. Problems did arise in the command's large military camps, but, with few exceptions, they were efficiently cared for by the medical officers assigned to those stations. The line officers at Camp Roberts, however, never could be convinced that their training program created more casualties

than necessary. Marching double time on paved areas when fatigued would keep a ward or two filled with march or fatigue fractures.

On one occasion, Fort Lewis developed a sudden paralysis of its medical dispensary system when the troop concentration there became high. This failure of the dispensary system led to a breakdown of the station and general hospital services. In order to get patients out of the dispensary, they were sent for laboratory and X-ray investigation. Consequently, they stood in line waiting to get in dispensaries, laboratories, and X-ray stations, thereby creating a traffic jam in medical service. In the absence of other consultants, the service command surgeon was forced to send the orthopedic consultant for investigation of the medical situation at Fort Lewis. This is mentioned only because it gave the consultant an opportunity to provide a diagnostic screening service for the dispensary medical officers, thereby protecting both the station and general hospital inpatient and outpatient services from being overloaded. An internist, surgeon, psychiatrist, and orthopedist were put in charge of this screening and diagnostic service. These medical officers organized a course of instruction for the dispensary officers and trained them in techniques of examination so that only problem cases would come from the dispensary to the screening and diagnostic service. The dispensary officers were allowed to attend consultations when possible. Such organization greatly improved the morale of the dispensary officers who had previously felt as though they were being left out of things. It also gave the service command an opportunity to use several medical officers of high rank whose ability had not been fully utilized in their former assignments. These officers made a real contribution and gained a sense of personal accomplishment which up until that time they had not enjoyed. The process of finding the right man for the right job and having him dedicate himself to it and consequently feel that he had served his country fully, gave this author a gratification probably as great as any other that he had while in the service.

Integrated Physical Rehabilitation

After another tour of inspection of the general hospitals, Colonel Loutzenheiser found that little was required of him for the proper functioning of their orthopedic sections. Unanimously, the chiefs of orthopedic surgery had suggested that an improvement in the coordination of physical and occupational therapy was indicated. As the census increased in the hospitals, the physical therapy departments became overloaded and it was difficult for the physical and occupational therapists to get their work done with the limited number of personnel assigned to these tasks. Inasmuch as these therapists were most important to the care of orthopedic patients, recommendation was made that they be coordinated and work as one therapy team.

The orthopedic consultant, with his interest in establishing effective rehabilitation, soon found that he was involved with the reconditioning program.

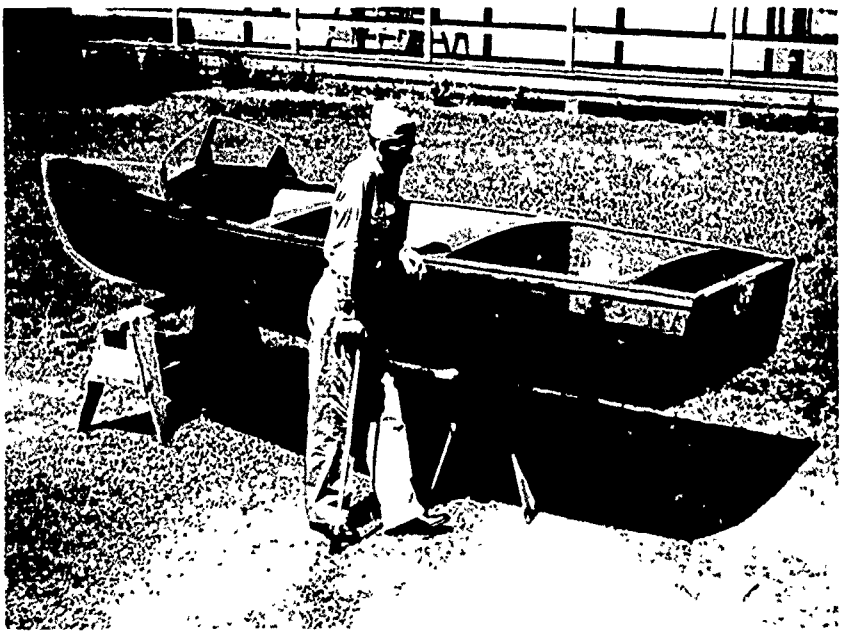


FIGURE 40 Patient in rehabilitation program at Baxter General Hospital, Spokane, Wash., proudly displays completed boat

Some of the psychological aspects of this program were excellent (fig. 40). A grouping of convalescent patients for physical restoration led to a greatly improved system of convalescent care. The employment of permanently handicapped for performing piecework in war industry while in the hospital was of great psychological benefit to these patients. There were many features, however, in the reconditioning program which led to confusion and bizarre interpretation. Many reconditioning activities should have been placed in a convalescent center or completely eliminated, as they had no place in a general hospital.

Certain facts were learned in the reconditioning program, however, and these indicated the way to develop a productive system of physical reconstruction. A production line for rehabilitative therapy was set up in most of the hospitals. Selected Women's Army Corps personnel were obtained and trained to do limited portions of physical therapy so that the well trained physical therapist was saved for the more important portions of her work. The departments of physical therapy were further assisted by the reconditioning officer and his assistants, who developed a heavy work and exercise program for patients who had reached that stage of recovery. In some instances, the patients were taught to treat each other when both would benefit from such treatment, particularly in cases of patients with hand disabilities or with amputations.

SPECIAL CENTERS

Integrated Reconstructive Surgery

In the course of time, the Office of the Surgeon General established a number of special centers in selected hospitals. On visiting hospitals so designated, the orthopedic consultant realized that the activities of the special center were taking precedence over all others in the hospital, with consequent loss of a sense of proportion for combining the interests of the special center with the rest of the hospital's activities. It took a good deal of doing on the part of all the consultants to make some of these centers realize their full obligation. In one instance, it was necessary to make a factual survey of the existing conditions within a certain hospital before full cooperation of the various sections could be gained for the development of a complete reconstruction surgical team. Recommendation was made for establishing a therapy conference of orthopedic and plastic surgeons and neurosurgeons who were to decide in each problem case the mode of procedure and the timing of the various and subsequent procedures that would be necessary to restore the patient. A followup report of these patients was made every week. Experience with such an integrated special therapy program proved that this was an advantage over methods used formerly. The recommendation was then made that special centers be combined into special reconstructive surgical centers. This was not accomplished by 1946, but this consultant felt that it would have been a better method than the one in use. Thoracic surgery might have remained as a single special center, but the other surgeries would have functioned more efficiently if they had been combined. Amputation centers might have been another exception to the idea of combined centers, as the need for group therapy, for amputation surgeons to work with limbfitters, and for special shops for prosthetic manufacture presented a problem best handled in a single special center.

Amputations

Prosthetics research.—The amputation center in the Ninth Service Command was located at Bushnell General Hospital, Brigham City, Utah. This hospital was located within 60 miles of service command headquarters, and the orthopedic consultant was ordered as his first duty to make a comparative study of the Army and Navy amputation prostheses. As a result of this duty, an amputation prosthesis research center was established and financed at the start by Mr. John Northrop of the Northrop Aircraft Company. This consultant was responsible for Mr. Northrop's interest in this field and worked with him and his engineers during the last 2 years of the war. Improvements were made in upper extremity prostheses with the use of lightweight metals and plastics and with the application of latest engineering principles (fig. 41). On the artificial legs, plastic sockets were developed to replace those made of leather. The Committee on Prosthetics Services, National Research Council, reported these research activities in considerable detail with due credit to this consultant

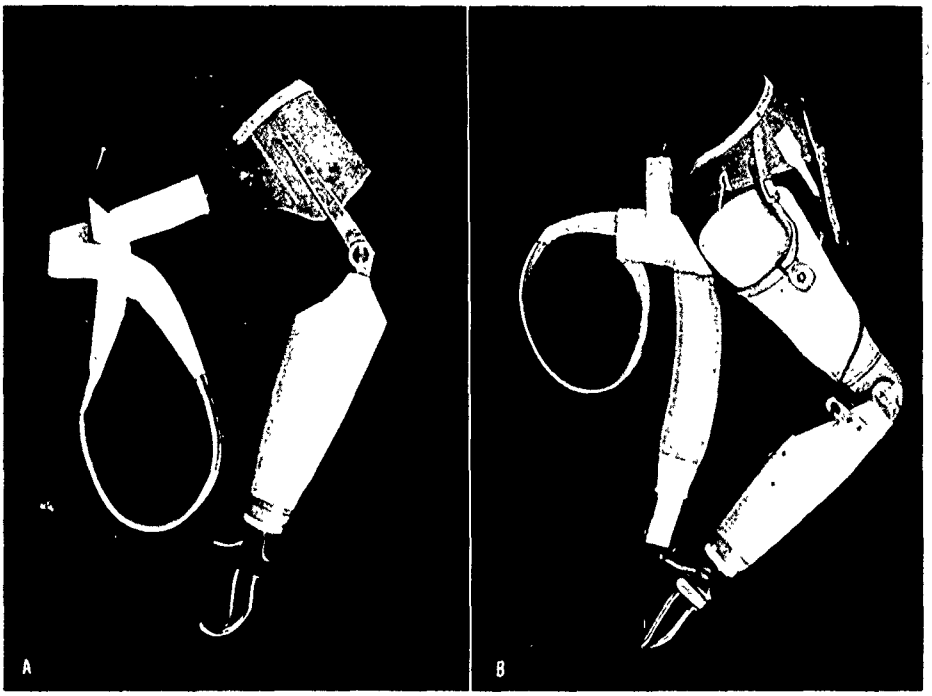


FIGURE 41. Northrop prostheses for the arm. A. For lower-arm amputations. B. For upper-arm amputations.

at a symposium[1] on research projects held in Chicago, Ill., on 16 and 17 January 1946.

By the end of 1945, the amputation center at Bushnell General Hospital maintained a census of between 1,000 and 1,500 patients, which made an operative schedule of 150 to 200 amputations a month necessary. The amputation prosthesis shop was enlarged to take care of this load, and new methods were instituted to allow the completion of 150 to 200 prostheses a month. Plastic sockets were now made in one fifth the time that it had taken to make a leather socket, and it was proven that these plastic sockets were odorless and were better fitting and cleaner than, and just as durable as, leather sockets. Plastic material was also used in the manufacture of the upper extremity prosthesis and gave the artificial arm a cleaner and more efficient appearance. Further research included an improvement on the elbow joint, which would allow automatic locking and unlocking, and an improved mechanical artificial hand, which could be covered with an acrylic, specially treated latex glove which would have the natural appearance of a hand. This consultant felt that the ideal artificial hand should have three dynamic digits. Such a hand could take an object out of a

[1] Research Reports on Artificial Limbs. First Annual Report of the Committee on Prosthetics, National Research Council, 1 April 1946, pp. 17–21.

pocket. The rigid artificial hand could not do this. At that time, the grotesque hook was the only practical substitute for a hand.

ORTHOPEDICS IN GENERAL AND STATION HOSPITALS

After study of the amputation centers and initiation of prosthetic research, the problems of the general and station hospitals occupied the major portion of the orthopedic consultant's time. Inspection of the orthopedic services at 12 general hospitals and twice that number of station hospitals demanded too much time but was a necessary background for learning the problems of each hospital, as they were all dissimilar. The major problems to be solved were (1) placement of personnel best fitted for their job, (2) development of adequate facilities within the hospital to allow the work to be done efficiently and rapidly, (3) arrangement for proper movement of patients with particular regard to the pathological situation, (4) coordination of physical and occupational therapies into one therapy program, and (5) organization of effective rehabilitation programs for the convalescent patient.

Orthopedic Personnel

The personnel problem was always difficult but not insurmountable. There was never adequate personnel. The problem was solved in part by utilizing the well trained to the best advantage and having them train additional personnel to do limited surgery (the same procedures again and again until the junior surgeons had reached a high degree of proficiency). This allowed the trained orthopedic surgeons to complete the major definitive surgery. The chiefs of orthopedic surgery were selected for surgical ability and quality of leadership. Their personal accomplishments, devotion to duty, and kindness to their patients were more than noteworthy. It was their outstanding character that inspired so many young surgeons to become orthopedic surgeons. The problem of personnel placement divided itself into several components, as follows: (1) Selection of department heads (chiefs of sections), (2) evaluation and assay of personnel to work with the chiefs of sections, (3) training of medical officers for limited special surgery, and (4) movement of any orthopedic officer for betterment of service.

Selection.—The method used for selection of chiefs of section was satisfactory. The Office of the Surgeon General assigned an orthopedic surgeon to the service command with a recommendation that he be made chief of section. The service command knew the needs and usually made proper placement of the qualified officer. In the Ninth Service Command, the service command surgeon ordered the consultants to work with the personnel officers in all problems of placement and transfer within the service command. This order resulted in many benefits as the consultants knew the personnel intimately as to person-

ality, ability, and leadership; and the personnel officer knew only their names, grades, and classifications.

Evaluation.—The evaluation or assay of orthopedic officers was accomplished soon after their assignment. Three months of on-the-job service was usually an adequate period for evaluation, although there were times when one month proved to be adequate. Only a few of the officers who had been certified as orthopedists by the American Board of Orthopedic Surgery were incapable of acting as chiefs of sections. These few had acquired little training in the surgery of trauma and were of necessity trained within the service command. Occasionally, the transfer of such an officer would lead to misunderstanding between the Office of the Surgeon General and the service command. The opportunity to evaluate orthopedic officers for particular assignments occurred in the Ninth Service Command by the end of the year 1943.

Training.—As early as 1942, the problem of training officers for particular assignments was answered by the assignment of medical officers to permanent general hospitals, such as Letterman General Hospital, San Francisco, Calif. In this hospital, the surgical services were well organized, and teaching services were easily established with superior personnel working in a city where two medical schools were located and were willing to assist in any teaching problem. Later, other hospitals had to be used for teaching and training centers since Letterman General Hospital became more and more concerned with the receipt and disposition of casualties from oversea theaters. Well-staffed and well-organized orthopedic, plastic, amputation, and neurosurgical sections were used to train and evaluate medical officers with surgical training assigned to the command. In this manner, particular surgical talents in the young surgeons were developed and they became more useful for oversea or general hospital assignments.

Transfers.—The need for moving medical personnel from one hospital to another has been mentioned earlier in this discussion. One had to be certain that the transfer of a valuable medical officer was demanded by need for improvement of the service. All the reasons for the transfer of an officer had to be fully justified, or the consultant would have been considered fanciful and untrustworthy. When transfer was justified and allowed, there was considerable inconvenience and Government expense occasioned. Consequently, transfers or changes of station within the service command of married officers had to be infrequent. During war, there is no situation which can be considered completely static or stationary. The personnel one has today may be gone tomorrow, and the consultant's recommendations of last week may appear stupid and ridiculous next week because of a change in events over which he has no control. The safest course was to postpone the action believed advisable and save this move on one's mental checkerboard for the day he might be forced to make it. The following phrase is used by tacticians for this method of procedure: Never do today what you can do better tomorrow.

Facilities

The second major problem—that concerning adequate working conditions within the hospital for optimal care of patients—was a real and serious problem. General hospitals were built on plans which were outmoded for the existing needs. The development of facilities for efficient orthopedic care could have been planned in advance, but such facilities were totally inadequate in the newly constructed general hospitals of 1942. Recommendations should have been presented to hospital commanders for the best utilization of existing accommodations to provide adequate orthopedic space. As it was, hospital commanders opened their hospitals with these fixed plans and gave one the impression that they would be criticized by higher authority if they deviated from them. Also, the surgical consultants who were burdened with all the early problems had too many troubles to worry about orthopedic facilities. Should there ever be a "next time," orthopedic consultants should be appointed at the start along with other consultants in the major branches of military medicine and surgery. Although this consultant had the privilege of serving with a helpful, cooperative group of consultants under efficient and loyal commands, it remained his opinion that orthopedic surgery should have been given a place equally important as so-called general surgery. There was a need for a specially trained liaison officer to coordinate the surgical specialties for the hospital. Such an officer could have served on the same level with the executive officer under the hospital commander and eliminated considerable interservice and section friction. The presumed and actual higher authority of a chief of surgical service was too often a roadblock to the rapid improvement of facility for, and service to, patients.[2]

Proper Movement of Patients

The third of the listed major problems pertained to the need for proper movement of patients with particular regard to the pathological situation. This problem could be further divided into three areas where improvement was needed: (1) Selection of patients to be held for continuing care upon their arrival at a general hospital, (2) transfer of appropriate patients to special centers where their care could be better accomplished, and (3) movement of patients within a hospital to give them a proper psychological attitude toward their own individual problems.

Experience in the Ninth Service Command noted the difficulties and dangers of mass movement of patients in their evacuation from one hospital to another, both within the command and from overseas into it. Fractures of long bones were subject to multiple changes of immobilization apparatus during a period of repair which resulted in displacement of fragments, delay in healing,

[2] The organization plan for a general hospital now includes the position of a chief of professional services to coordinate all professional activities, but a chief of surgical service still retains the direct responsibility for supervising all surgery in the hospital.—J. B. C., Jr.

and loss of joint function. Delay in early wound cleanup (after wounding) led to serious surgical disaster. The Army Air Forces performed a magnificent job in air evacuation, but failure by medical officers to think in terms of pathological time caused irreparable damage to occur in a wounded extremity which should have been surgically cleaned up or debrided within the so-called golden hours before bacterial fixation in avascular tissue. Air transport might have allowed emergency surgery to be performed at considerable distance from the place of wounding, but it had to be performed within the time limits decreed by the pathological situation. Simple bullet wounding occurring where gas bacillus contamination existed resulted in extremity amputation when the patient was transported by air for too many hours before stopping for surgical cleanup. Granting that there may have been overriding military situations, many patients who would have benefited from air evacuation spent excessive periods in oversea hospitals in the Pacific awaiting ship transport to centers for definitive care. In a number of instances, the care could have been provided where they were. Mass evacuation and "thou shalt not" orders from higher authority presented greater dangers than the evils they were designed to prevent when careful screening of pathological conditions and selection of patients for evacuation did not occur. Every medical officer should have recognized that care of the patient was a personal responsibility and the orders designed for overall improvement in care did not lessen his personal obligation to the patient.

Effective Rehabilitation and Convalescent Programs

Long-term planning.—Efforts to coordinate a complete rehabilitation plan for the sick and wounded were made in the Ninth Service Command before the inception of formal reconditioning programs. Ideas prevailing in the Ninth Service Command differed considerably from those presented in some portions of the reconditioning program. Rehabilitation, in the Ninth Service Command concept, began prior to definitive care. Orthopedic surgeons were requested to plan the entire surgical reconstruction before performing the first definitive operation. Surgery was considered an important part of rehabilitation and often the most important part. Envisioning the entire course of rehabilitative care often eliminated procedures which promised little benefit in the total care. The important question that arose in such planning conferences was the following one: What will be the optimal end result if all goes well? The next important question, which had to be answered in the monthly followup review of such problem cases, was the following: Should our original opinion regarding optimal end result be changed? An optimal end result was considered the best that one could obtain in a given pathological condition. Once this type of thinking governed decision as to surgical procedure and followup care, a satisfactory base was established for a sensible productive system of reconstructive surgery and patient rehabilitation. After

one year's experience in a general hospital with such a plan, the consultant encouraged other hospitals to design a system of orthopedic care based on long-term thinking rather than on short-term thinking.

By 1945, this consultant was convinced that the plastic surgeons and the neurosurgeons should participate with the orthopedic surgeons in a planned system of surgical reconstruction. Thereafter, the procedure was adopted wherein a weekly group meeting of these specialists determined the future surgical course of patients whose pathological problem involved the three specialties. The benefits in patient care accruing from these methods suggested that hospitals with these three surgical specialties should act as centers for reconstructive surgery and should be so designated.

Convalescent hospitals.—In 1945, the Ninth Service Command was ordered to establish convalescent hospitals which actually were to function as rehabilitation centers, should the war continue into 1946–47. Complete facilities for these centers were set up at Fort Lewis and at Camp Mitchell, Calif. These camps had some accommodations already available which made the early establishment of such centers possible. Unfortunately, neither convalescent center was climatically suited for its purpose. The handicapped and disabled soldier in actual need of rehabilitation should have had a comfortable climatic environment. Although there was an excellent group of officers in charge of the convalescent centers and an efficient rehabilitation plan was in action, it soon became obvious that the patients were not happy in their surroundings. The following two conclusions were drawn from observation of the two convalescent centers of the Ninth Service Command: (1) The truly disabled and handicapped were anxious to receive adequate medical care in addition to retraining for a new occupation which they could carry out with their known handicap and (2) many patients who had no real need for convalescent care were sent to a convalescent center. It was further concluded that careful study of the rehabilitative needs of various types of patients was necessary before designing a convalescent hospital. A common fault in hospitals seeking to rid themselves of the ambulant chronic complainer was to send him to a convalescent hospital. This was the type of patient who did not belong in a rehabilitative facility which dealt with the truly handicapped and disabled.

Résumé of Hospital Orthopedic Care

During the last year of the war, orthopedic sections geared to care for 400 orthopedic patients found themselves with a census of 800 to 1,000 patients. The total census increased until in late 1945 a peak load of 13,000 orthopedic patients, excluding those in station hospitals, were being cared for in the Ninth Service Command. By that time, the hospitals were well equipped to handle their surgical load. A few hospitals which never should have been anything more than medical centers were obliged to carry on with large censuses of surgical patients with only three available operating rooms. The staffs of

these hospitals deserve special commendation for taking exceptionally good care of their patients. The training systems devised one year before were now paying dividends, and there were now many young surgeons able to assist the limited number of orthopedists in doing their work.

Experience during the period of 1944–45 occasioned two recommendations. One of these was that smaller station hospitals should not have an orthopedic section inasmuch as directives from the Office of the Surgeon General prohibited the performance of any major orthopedic surgery in that type of hospital. The other recommendation was that reconstruction centers be created which would allow neurosurgery, plastic skin repair of the extremities, and orthopedic surgery to be performed in the same hospital. It was found that orthopedic care in convalescent hospitals was best accomplished when officers trained in disability evaluation were placed in charge of the convalescent physical restoration of these patients. It was further recommended that each of these medical officers be trained in a center for surgical restoration, supervising both physical and occupational therapy and the physical reconditioning of his patients.

COMMENT

The Ninth Service Command owed a debt of gratitude to Dr. Leroy Abbott, professor of orthopedic surgery at the University of California School of Medicine, who on several occasions toured the service command general hospitals offering advice and stimulating the orthopedic medical officers on duty. This consultant has already praised the work of the orthopedic surgeons who served in the Ninth Service Command, but he would be remiss if he failed to emphasize the dedicated work of Colonel Myers at Bushnell General Hospital. This great gentleman and accomplished surgeon worked 16 hours every day caring for his patients, and his tremendous workload brought him well past the point of physical exhaustion from which he never fully recovered.

SUMMARY

In summary of Colonel Loutzenheiser's experiences as consultant in orthopedic surgery for the Ninth Service Command in the years 1944 and 1945, the following final suggestions are offered for further consideration:

1. The orthopedic consultant to a service command should be carefully indoctrinated before reporting to his assignment.

2. The War Department should design a military hospital planned for needs of the future rather than for those of the past.

3. Orthopedic surgery should be recognized as a major branch of surgery in relation to the care of war wounded.

4. A combination of orthopedic surgery, plastic surgery, and neurosurgery into reconstructive surgical centers is most important.

5. Contrawise, separate centers for orthopedic surgery, plastic surgery, and neurosurgery are disadvantageous and lead to multiple transfers and delay in patient care.

6. Reconstructive surgical centers should be located near large centers of population and their medical schools. Convalescent hospitals should be placed in optimal climatic areas for final rehabilitative care.

7. The consultant should have adequate rank in order to meet commanding officers on a proper military level, and it should be established that the consultant represents the Office of the Surgeon General insofar as his duties require implementation of clinical policies and practices promulgated by that office.

Part II

SURGICAL CONSULTANTS TO FIELD ARMIES IN THEATERS OF OPERATIONS

CHAPTER XV

Third U.S. Army

Charles B. Odom, M.D.

Section I. Administrative Considerations

The Third U.S. Army created a number of records. It traveled farther and faster on the ground than any army in history. In the 281 days between 1 August 1944, when this Army became operational, and 8 May 1945, when the instrument of German surrender was signed, it moved from the invasion beaches of France to the Austrian Alps. During this period, the Third U.S. Army captured 1,280,688 prisoners, killed 144,500 enemy troops, and wounded 386,200 others.

The medical service of the Third U.S. Army also set records.[1] During the period cited, it treated a total of 313,686 persons, including 5,225 civilians and 23,536 enemy personnel.

Between 1 August 1944 and 30 April 1945, the following casualties were hospitalized in Third U.S. Army hospitals:

Designation	*Casualties*
U.S. troops	91,454
British Army troops	506
French Army troops	3,095
U.S. Navy and Marine Corps personnel	205
British Navy and French Navy personnel	6
Enemy forces personnel	16,989
Civilians	2,635
Others, specifically French Forces of the Interior	188

For the 91,454 U.S. Army battle casualties admitted during this period, the case fatality rate was 2.73 percent. Wounds in these casualties were divided into 23,283 serious and 56,676 slight, excluding the 11,495 wounds incurred in December for which no breakdown is available. The 91,454 wounds are classified as to anatomic location in table 3. The case fatality rate for the first 5 months during which the Army was operational, 2.9 percent (table 4), was reduced to 2.6 percent during the remaining months of combat. The highest case fatality rates were in wounds of the abdomen, wounds of the head and spine, and wounds of the chest (tables 3 and 4).

[1] (1) Semiannual Report, Surgeon, Third U.S. Army, ETOUSA, 1 Jan.–30 June 1945. (2) Annual Report, Surgeon, Third U.S. Army, ETOUSA, 1945.

TABLE 3.—*Admissions for and deaths due to wounds among casualties hospitalized in Third U.S. Army hospitals, by wound classification, 1 August 1944–30 April 1945*

Wound classification	Admissions	Deaths
Wounds other than burns:		
Abdominal	4, 203	657
Thoracic	8, 020	623
Maxillofacial	5, 697	51
Neurologic [1]	7, 387	651
Upper extremity	22, 919	66
Lower extremity	33, 057	304
Buttocks	4, 363	98
Other	4, 795	79
Total	90, 441	2, 529
Burns, all locations	1, 013	27
Grand total	91, 454	2, 556

[1] Of the 7,387 admissions for neurologic wounds, 5,776 were for wounds of the head, with 562 deaths; 521 were for wounds of the spine with 82 deaths; and 90 were for wounds of the nerves with 7 deaths.

TABLE 4.—*Analysis of 48,354 U.S. battle casualties treated in Third U.S. Army installations, 1 August 1944–1 January 1945*

Anatomic location of wound or injury	Total cases		Total deaths	Case fatality rate (percent)
	Number	Percent [1]		
Wounds or injuries other than burns:				
Head	3, 008	6. 22	336	11. 17
Face and neck	3, 007	6. 22	28	. 93
Chest	4, 401	9. 10	348	7. 90
Spine	778	1. 61	28	3. 59
Abdomen	2, 162	4. 48	349	16. 14
Buttocks	2, 348	4. 85	53	2. 25
Upper extremity	12, 646	26. 15	42	. 33
Lower extremity	16, 812	34. 77	180	1. 07
Other	2, 533	5. 24	50	1. 97
Total	47, 695	98. 64	1, 414	2. 96
Burns, all locations	659	1. 36	18	2. 73
Grand total	48, 354	100. 00	1, 432	2. 96

[1] Percentage of grand total.



FIGURE 42.—Lt. Gen. George S. Patton visits the 12th Evacuation Hospital to award decorations to the wounded.

It would be impossible to report on the work of the surgical consultant to the Surgeon, Third U.S. Army, without making mention of Lt. Gen. (later Gen.) George S. Patton, Jr., USA, the Commanding General. Contrary to the impression held by many who did not know him, he was an extremely kind and very humane individual. This was reflected in his interest in those under his command. He had the greatest concern for the welfare of all his troops, mo[illegible]particularly those who had been injured in battle (fig. 42). He was not satisfied with mere statistical reports of casualties. He wanted to see for himself that the wounded were properly cared for, and, while this plan was not generally practical for an officer in his position of command, he made many unscheduled and unheralded visits to hospitals to see the sick and wounded. When he could not see them himself, he wanted direct reports from medical and other officers who had seen them. From the campaign in Sicily when General Patton was the Seventh U.S. Army commander, to the end of the war, preparing these reports was one of the chief duties of the surgical consultant.

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FIGURE 43.—Col. Charles B. Odom, MC, Consultant in Surgery to the Surgeon, Seventh U.S. Army, and, later, Consultant in Surgery to the Surgeon, Third U.S. Army.

General Patton had the faculty of inspiring truly magnificent loyalty in those who were associated with him. As a result, although his demands frequently verged on the impossible, somehow or other the impossible tasks that he asked his staff and his troops to perform were usually accomplished with skill and dispatch.

THE CONSULTANT SYSTEM

Evolution of the System

When the United States entered World War II, there was no consultant system, and no provision for one, in the Army Medical Department, although World War I had seen the development of a very complete consultant system in the AEF (American Expeditionary Forces). The system was again developed in World War II because it was found to be necessary.

It was of gradual evolution. It was first employed in ground combat in the Southwest Pacific and Central Pacific Areas. In the North African (later Mediterranean) Theater of Operations, Col. Edward D. Churchill, MC, served as Consultant in Surgery to the theater Surgeon, and Maj. (later Col.) Howard E. Snyder, MC, who was later Consultant in Surgery to the Surgeon, Fifth U.S. Army (p. 333), served as Consultant in Surgery to the Surgeon, II Corps.

The Sicilian campaign, which was short and brilliant, did not produce a great number of battle casualties. Shortly after it began, Lt. Col. (later Col.) Charles B. Odom, MC, (fig. 43) was appointed consultant to the Surgeon, Seventh U.S. Army, but, because of the brevity of the action, the role of consultant did not come to the full realization which it was to assume later in the campaign in Italy and in the campaigns in the European theater.[2] Nonetheless, the Sicilian campaign furnished a background of experience which later proved valuable.

Functions of the Surgical Consultant

The surgical consultant in a field army served first of all to bridge the gap which had previously existed between Regular Army medical officers, who

[2] Colonel (then Major) Odom began his military service with the 64th General Hospital, the Louisiana State University School of Medicine Unit, which was sent to Fort Jackson, S.C., in 1942 for training. Shortly afterward, Colonel Odom was transferred to Fort Knox, Ky., where, in order to create additional hospitals, personnel from a number of general hospital units were being assembled. The staff of the 91st Evacuation Hospital, in which he was appointed chief of the surgical section, was organized with officers transferred from the affiliated units from the Louisiana State University School of Medicine at New Orleans and the medical schools of the University of Oregon, the University of Rochester, Yale University, and Harvard University.

The 91st Evacuation Hospital was sent to North Africa in November 1942, as a component of the II Armored Corps (Western Task Force), under the command of General Patton. The mission of these troops was to secure beachheads and bases on the coast of Morocco.

Following the Tunisia campaign, the 91st Evacuation Hospital was ordered to Algeria, where it began training for the invasion of Sicily. Just before the invasion, Colonel Odom was placed at the head of a surgical team which was assigned to the S.S. *Monrovia*, General Patton's command ship. On the morning of the invasion, Colonel Odom went ashore with the assault troops at Gela, and in July 1943, during the course of the Sicilian campaign, he was appointed surgical consultant to the Surgeon, Seventh U.S. Army.

In December 1943, after sitting out the storm of publicity precipitated by the so-called slapping incident, General Patton departed from Palermo alone by plane. The officers left behind in his headquarters had no idea whether he would receive a new assignment or would be retired. The answer came 2 weeks later, when Brig. Gen. (later Maj. Gen.) Hobart R. Gay, USA, his chief of staff, and a number of other officers from various sections of the Seventh U.S. Army were ordered to England. Colonel Odom, who had remained with the Seventh U.S. Army Headquarters after the Sicilian campaign, was the medical officer selected to accompany him.

Upon their arrival in England, by way of Algiers, Algeria, Casablanca, Morocco, and Prestwick, Scotland, these officers joined General Patton, who, meantime, had been appointed Commanding General, Third U.S. Army, at Peover, a small village near Knutsford in the Midlands. Here, preparations were in progress for receiving the Third U.S. Army headquarters from Fort Sam Houston, Tex. When the headquarters arrived, General Patton assumed command, and the officers who had been ordered up from North Africa were integrated into the headquarters staff.

Colonel Odom became surgical consultant to the Surgeon, Third U.S. Army, remaining in this position throughout the fighting in Europe. In June 1945 he was appointed chief of surgery at Brooke General Hospital, Fort Sam Houston, and remained in this position until he was separated from service in December 1945.

It would be impossible to report on the work of the surgical consultant to the Surgeon, Third U.S. Army, without making mention of General Patton's relation to him. Colonel Odom's first contact with General Patton was in the hospital unit set up in Mostaganem, Algeria, which was receiving casualties in May and June 1943. He went ashore on the same landing craft with him in the Sicilian invasion and was billeted at the same place with him on the first night ashore.

Colonel Odom's position thereafter was not only that of surgical consultant but, in a sense, that of personal physician to General Patton throughout the war in Europe. This relation undoubtedly played a part in the role of the surgical consultant to the Third U.S. Army surgeon. One of its first results was that during the planning in England for D-day Colonel Odom lived with General Patton's immediate staff and had full access to all planning, including the top secret plans developed in the war room. Unlike consultants of some other armies, he therefore had the advantage of knowing all that was necessary to know for the preparation of medical facilities for the invasion and could thus fulfill his own duties and responsibilities as efficiently as possible.—J. B. C., Jr.

had been trained in Army discipline, line of command, and other medicomilitary matters, and the medical officers fresh from the civilian practice of medicine, who were individualists, who were concerned only with medicine, and who had to learn that the sick and wounded must be treated with regard to medicomilitary considerations as well as by the techniques of civilian practice.

The surgical consultant to the Surgeon, Third U.S. Army, had the same duties as surgical consultants in other field armies. He advised the Surgeon on a variety of matters, such as (1) evaluation and assignment of personnel, (2) organization and functioning of surgical sections of hospitals in the forward area, (3) the quality of medical service rendered, with suggestions for its improvement, (4) changes in concepts and techniques of surgical management of combat injuries, (5) indoctrination of new medical personnel, (6) the results being obtained in the care of battle casualties, and (7) future planning.

Colonel Odom, as already noted, was closely associated with all medical planning for invasion of the Continent. Although the Third U.S. Army did not become operational until 1 August 1944, Colonel Odom arrived in France with the Third U.S. Army surgeon on 6 July, and from the onset of the campaign he worked from that portion of the office of the army surgeon, which was located at the forward echelon of Third Army headquarters.

Colonel Odom's location in the forward echelon gave him the best possible opportunity to keep in close touch with the tactical situation and to be fully informed concerning casualties. Each morning, he was privileged to attend the war room conference of key members of the headquarters' staff, an experience which was extremely interesting in itself and which made it possible to anticipate where the heaviest action would occur and where the greatest number of casualties must be cared for. The Operations and Training Subsection, Medical Section, Third U.S. Army, at the forward echelon maintained a map on a day-by-day basis which showed the distribution of all medical units and all surgical teams. This information made it possible to provide prompt and efficient medical support for all units in action.

Colonel Odom worked out of the office in the forward echelon, sometimes being absent from it for several days at a time. In such circumstances, days sometimes elapsed between his reports to the Army surgeon's office, but on his return an informal report, at least, was always made on the conditions observed.

Movement from one medical unit to another permitted on-the-spot observation. In the Third U.S. Army, under General Patton's dynamic leadership, advances were frequently so rapid that keeping up with medical units was something of a problem in itself (fig. 44). Full provision, however, was made for Colonel Odom's transportation. A driver and jeep were regularly assigned to him, and, if hospital units were too widely separated for ground transportation to be practical, he was assigned a cub observation plane and a pilot. A



FIGURE 44.—Evacuation by light tank for speed, protection, and negotiating muddy terrain.

plane of this size could be landed in the field next to a hospital, and its use saved much time in moving around the army area.

Col. (later Brig. Gen.) Thomas D. Hurley, MC, Surgeon, Third U.S. Army, and Col. John Boyd Coates, Jr., MC, Executive Officer, had the task of supporting the advancing Army by leapfrogging medical units which were leapfrogged across each other. Since the surgical consultant moved with the command post of the army, it was often possible for him to recommend advantageous hospital locations to the Operations and Training Subsection. Also being thoroughly familiar with the abilities and capacities of the various medical units, he was often able to recommend the use of one unit instead of another as better suited to the immediate job to be done.

Finally, because of his close observation of their work, the surgical consultant was able to recommend that one or another unit be given a few days' rest. These recommendations were almost invariably followed by the Operations and Training Subsection. This policy held for the larger units as well as the smaller units and even for individuals. When surgical teams had been

through a particularly busy period, it was customary to transfer them temporarily into less busy hospitals in rear areas.

Colonel Odom did a certain amount of surgical work himself, partly for demonstration purposes and partly to help out hard-pressed surgical teams when the number of casualties was particularly heavy.

He also performed a number of operations in evacuation hospitals, some of which, except for the desire to keep key personnel in headquarters, would have been handled in general hospitals in the communications zone, or even in Zone of Interior hospitals.

Between the Sicilian campaign and the invasion of Normandy, for instance, Colonel Odom performed a bilateral inguinal hernioplasty on the Chief of Staff, Seventh U.S. Army. The result was excellent, and the latter officer was able to remain active throughout the campaign on the Continent and, later, made an outstanding record as Commanding General, 1st Cavalry Division, in the Korean War. Also, General Patton's ordnance officer was operated on for intestinal obstruction; a segment of bowel was resected, and he was returned to duty in Third Army headquarters within 2 weeks.

A unit commander who had sustained a serious abdominal wound was brought out of a German Army prison camp while the battle for the town in which it was located was still in progress. Two cub planes were flown into the camp, with Colonel Odom in one of them. After blood transfusion and sedation, the patient was flown out of the camp in the other plane and was soon on the operating table in an evacuation hospital a few miles behind the front-line. This officer is still in service.

Still another officer in headquarters was operated on for acute appendicitis; he was back on duty within a week, without ever leaving the army area. The assistant G–2 lost an arm in a German hospital when he was taken prisoner in a skirmish late in the European fighting. When he was located and recaptured by U.S. Army patrols, revision of the stump was carried out in an evacuation hospital, and he remained on duty until the end of the war.

These and other operations were performed by the surgical consultant with the full knowledge and approval of General Patton, who believed most strongly in the doctrine of keeping all personnel, particularly key personnel, in the army area, so that they would not lose contact with their units. It was a tremendous boost in morale for a wounded soldier to return to his own unit, and an equal boost for the morale of the unit to which the man was returned. It also improved the prestige of the Medical Department, for it furnished concrete evidence to the troops that when they were ill or injured they would be cared for promptly and competently.

PLANNING IN THE UNITED KINGDOM BASE

During the first 2 months after medical planning began in the United Kingdom for the invasion of the Continent, the weather was typically rainy, foggy, and cold, but physical circumstances were otherwise propitious for

efficient operations. Field grade officers were billeted in private English homes, not more than a mile or two from headquarters, and other officers were also near at hand.

Certain major problems faced the medical service of the Third U.S. Army before the invasion of the Continent (Operation OVERLORD), as follows:

1. Preparation and intensive study of the medical plan for this operation.

2. The reception, acquisition, preparation, training, and briefing of medical units assigned to the Third Army.

3. The preparation of a medical supply plan and the procurement of supplies and equipment, including the improvisation of substitutes for what was not available in sufficient quantities for distribution to all units before the invasion.

Indoctrination

Probably the major problem that confronted the professional service of the Third U.S. Army during the early months of 1944 was the dual necessity of orienting medical units for combat duty and of rounding out and balancing the specialty staffs of the hospital units.

Among all the hospital units assigned to the Third Army, only the 16th Field Hospital had had any combat experience before it went into action in ETOUSA (European Theater of Operations, U.S. Army). Most units had had some maneuver experience, but a few had had little service or none at all in the field. The 91st Evacuation Hospital, which had had experience in the Mediterranean theater, went onto the Continent with the First U.S. Army, as did some of the other medical units originally assigned to the Third Army. These units, which landed in Normandy late in June and during July, functioned under the Surgeon, First U.S. Army, during this period, as did the surgical consultant to the Surgeon, Third U.S. Army. When the Third Army became operational on the Continent on 1 August 1944, these units reverted to it.

To compensate for these deficiencies in training, which were immediately obvious when the planning for the Normandy invasion was begun, a formal orientation course was planned and carried out.

Course of instruction.—Informal indoctrination and briefing were, of course, a continuous process, but a formal 7-day course was conducted at Peover Hall, Knutsford, Cheshire, England, in order to provide maximum background to personnel who would perform professional duties in the surgical and medical specialties in Army hospitals. The conference was attended by officers of the Medical Corps, Dental Corps, and Army Nurse Corps from the various hospital units assigned to the Third Army. The lecturers and other instructors included the chief and senior consultant for the theater in each specialty, as well as other medical officers with combat experience in the particular subjects under discussion. A wide variety of subjects were covered, with emphasis on the special procedures in each field which had been standardized in the light of the experiences in North Africa, Sicily, and Italy. Demonstrations were also pro-

vided, such as the arrangement of surgical equipment under tentage (p. 312). Special emphasis was placed on rapid as well as efficient functioning.

This 7-day course proved extremely beneficial. Among other advantages was the provision of a proper background on which medical commissioned personnel could base further study of the problems which they were to face in operations on the Continent. The planned, intensive instruction made it possible for many hospital units, even though they had no combat experience and many of their personnel had had little military experience, to adjust themselves rapidly to combat conditions and to treat and evacuate large numbers of casualties when the Third Army became operational on 1 August 1944 and the medical units were committed. The average medical officer, even without previous experience, soon learned to follow directions and comprehend why a certain routine was necessary, while at the same time he did not subordinate his own good judgment and individual initiative to it.

Later in the war, policies and practices devised at one unit and found efficient in it were conveyed to other units by the surgical consultant as he moved about the Army area, and they were soon in general use. All such items were included in the summary of events which the consultant submitted to the Historical Section, Third U.S. Army, at the end of each month and in the final summary submitted at the end of the campaign. It is devoutly to be hoped that these and other lessons learned in conflict will not again be forgotten, as so much was forgotten between World War I and World War II.

The orientation course just described provided an excellent opportunity for the hospital staffs to become acquainted with the army consultants, as well as with the theater consultants in the Office of the Chief Surgeon, ETOUSA. It is believed that this preliminary acquaintance had much to do with the cordial relations always maintained between army and theater personnel during the fighting in Europe. Col. (later Brig. Gen.) Elliott C. Cutler, MC, frequently made rounds in Third U.S. Army units with Colonel Odom, and much of the credit for the low mortality rate in battle casualties in the European theater is due to his efforts. Like all personnel in the theater chief surgeon's office, he was always most helpful when he was called upon for advice or other assistance.

Other courses.—In addition to the formal course just described, all existing facilities in the United Kingdom were used for the training of personnel in various specialities, particularly anesthesia and orthopedic surgery. Instruction in shock and transfusion at the British Army Blood Supply Depot, Southmead Hospital, Bristol, was made available for a small number of medical officers. A course for nurses, designed especially for the training of chief nurses and other key nurses, was conducted at the American School Center, Shrivenham, and proved extremely useful. A 1-day course in plaster techniques was conducted at the 10th Station Hospital in the Manchester area. All of these courses were planned to precede 30-day periods of temporary duty in these specialties in station and general hospitals.



FIGURE 45.—Intratracheal anesthesia in a field hospital platoon, with simultaneous administration of whole blood.

Perhaps the most useful of these special courses was the one in anesthesia, in which field one of the most serious shortages was discovered in the medical planning for D-day. This problem was solved by utilizing the experience of Maj. (later Lt. Col.) John R. Abajian, Jr., MC, who had taught anesthesia before entering the Army. He prepared a series of lectures and spent 2 or 3 weeks at a time in each field and evacuation hospital, demonstrating the administration of the various types of anesthesia and otherwise instructing the personnel assigned to anesthetic duty. By this means, it was possible to set up in each hospital a staff of three or four medical officers and the same number of nurses who had some fundamental knowledge of anesthesia. Anesthesiologists were trained in the same manner in auxiliary surgical teams.

By the time Major Abajian left a unit, he had succeeded in giving valuable instruction in both the theory and practice of the administration of anesthetics and had also given valuable assistance in the handling of casualties in the operating room. His work elevated the standards of both anesthesia and surgery in the Third U.S. Army (fig. 45).

In spite of administrative and other difficulties, which increased as the date for operations on the Continent approached, it was possible, during a 3-month period, to train approximately 1,000 medical officers and about 300 nurses in a number of professional and military subjects.

EVALUATION AND ASSIGNMENT OF PERSONNEL

While the orientation courses just described were in progress, specific action was taken to evaluate the qualifications and experience of all medical officers in the Third U.S. Army. Each officer filled out a questionnaire on his professional qualifications, and on the basis of a careful study of these records a considerable number of changes in hospital staffs were instituted. Qualified surgeons in the various specialties were transferred from posts in which their talents were likely to be wasted to posts in which their talents could best be utilized. In particular, a number of officers were transferred, for this reason, from other field units into hospital units or auxiliary surgical teams. In all, 78 Medical Corps officers were transferred to other posts between 30 March and 1 July 1944.

Most shifts in personnel were made on the basis of the recorded training and experience which the various medical officers had had before they entered upon their military service. After the Third U.S. Army became operational, evaluation was on a more practical basis, by direct observation of work in the field. It was then necessary to make a number of additional changes. Deficiencies in training became evident, and lack of leadership ability and personality difficulties often became apparent only after units had begun to function. When the ability of a surgeon came into question, as it sometimes did, the surgical consultant always checked on the complaint by direct observation before recommending any action.

The best method of adjustment, when these various difficulties arose, was usually to change the assignment. Medical officers who had been unhappy misfits in one organization were often happy and successful in another. In fact, the surgical consultant often served almost as a chaplain for medical officers who found it difficult to adjust to a military routine.

When there was a great deal of activity, as there was throughout operations on the Continent, changes in assignment were fairly easy to accomplish without delay or red tape.

When the Third U.S. Army embarked for the Continent, it was short about 25 Medical Corps officers, chiefly in the units which had been phased in late. The shortages were particularly serious in radiology, neurosurgery, and anesthesia.

It had been expected that these shortages would be overcome by a wider use of Medical Administrative Corps officers, but by the middle of November, when the last of these officers had been furnished to the Third Army, casualties among Medical Corps officers about equaled the paper surplus, and shortages in the Medical Corps continued to the end of the war.

Ophthalmology.—In the entire Third U.S. Army, there were originally only three officers trained as ophthalmologists. Two of them were in the same unit, a situation which was promptly corrected by the transfer of one of them to another unit.

The most experienced and best trained of these officers, in addition to his duties at his own unit, served as an auxiliary consultant, moving from one unit to another as his services could best be utilized. He was usually stationed in a forward evacuation hospital, where he could examine casualties with eye injuries and direct their treatment. His advice was very helpful in the preparation of directives concerning eye injuries.

Radiology.—A well-trained roentgenologist in one of the evacuation hospitals, Lt. Col. Frank Huber, MC, served as an auxiliary consultant to the surgical consultant, in addition to his work at his own unit. He visited other hospitals upon request and checked the work of the personnel and the adequacy of equipment in the X-ray departments. His advice was of great assistance in obtaining the best possible utilization of the X-ray equipment supplied for use in the field. One of his important duties was to check on the health of personnel engaged in X-ray work. He made sure that proper precautions were taken for their protection and directed routine blood studies, to be certain that they were not being deleteriously affected by radiation.

Colonel Huber also checked on the work of the three mobile X-ray units assigned to the Third U.S. Army. These units, which were part of the 4th Auxiliary Surgical Group, filled a dual deficiency. The table of organization for an evacuation hospital provided for only one roentgenologist, who obviously could not work day and night over the long periods of time the hospital was in active operation. The mobile units made it possible to reduce the waiting period in evacuation hospitals receiving a rush of battle casualties by providing qualified roentgenologic coverage over a 24-hour period (fig. 46). These teams were also useful in training inexperienced radiologic personnel in new units which joined the Third U.S. Army just before D-day and during active operations on the Continent.

The amount of X-ray work required in a field hospital did not justify the assignment of trained roentgenologists to these units. On occasion, however, when evacuation was not practical because of the tactical situation, as in river crossings, a mobile X-ray unit was attached to the field hospital platoon and served a very useful purpose.

Nursing service.—Nurses were always in short supply in both evacuation and field hospitals during rush periods, and the illness or incapacity of a single nurse could result in a serious situation. Too much credit cannot be given to the members of the Army Nurse Corps who worked side by side with surgical teams in units close behind the frontlines, often under shellfire, as well as in other forward installations. Their mere presence did a great deal for the morale of the troops.



FIGURE 46. Team of mobile X ray unit operating in an evacuation hospital in France.

Similar credit should also go to the enlisted men who worked valiantly and competently to care for casualties on the battlefield as well as in various forward installations.

MEDICAL UNITS

Field Hospitals

Early in the North African campaigns, it was found that one of the chief factors contributing to a low case-fatality rate in battle casualties was their treatment as far forward as possible (p. 370), with the echelon in which they were treated determined by the nature of their injuries. The campaigns in Sicily and Italy and later in the European theater further proved the value of early, skilled surgical care.

This care was best provided for nontransportable casualties in a reinforced platoon of a field hospital set up at the same level as the division clearing station, and sometimes in the same field or building. All casualties were funneled through the clearing station. Casualties were transferred to the field hospital, instead of being evacuated farther, when they were found to have multiple wounds or penetrating wounds of the chest and abdomen; when they were in

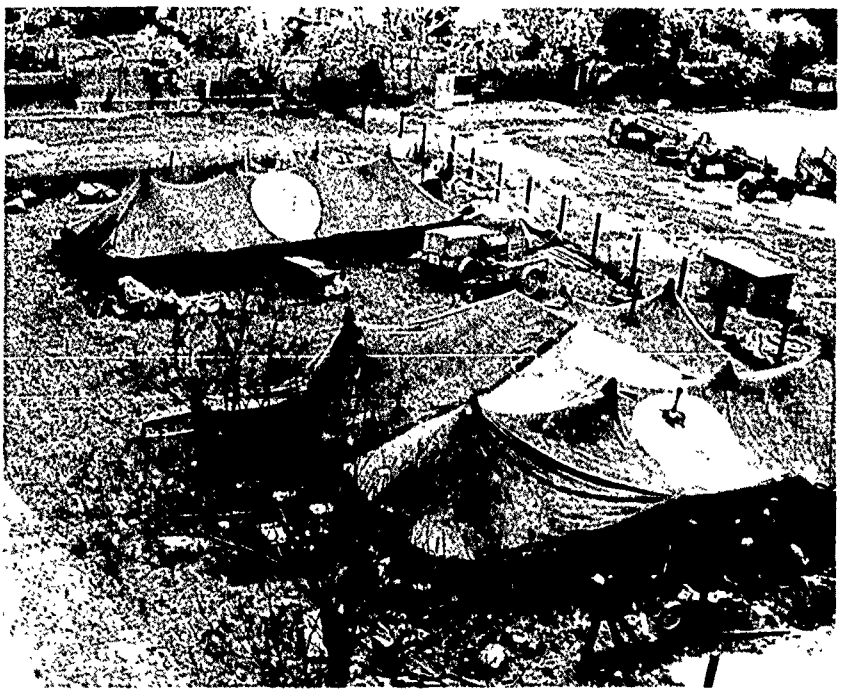


FIGURE 47. Initial stage of the establishment of a field hospital platoon. Hastily abandoned German equipment is in right background.

shock which did not respond promptly to appropriate therapy; or when for any other reason they required prompt surgical care and were unlikely to withstand movement to the rear without further deterioration.

No field hospital in the Third U.S. Army was employed as a unit, with a single exception—when such a unit was set up on the last day of 1944. Instead, field hospitals or portions thereof were attached to corps, which in turn attached active platoons of these hospitals to divisions for use in proximity to division clearing stations, as just described (fig. 47).

Theoretically, field hospitals were staffed and equipped to go to work immediately after their arrival in the theater. Actually, personnel assigned to them were seldom trained to do major surgery and usually had had little or no experience in this area. The field hospitals assigned to the Third U.S. Army had usually been trained for operation as station hospital type units and were unprepared for operations in the field. It was the consensus that such hospitals in the future should be trained under tactical or Army Ground Forces supervision, not under the supervision of Army Service Forces, to insure their receiving proper field and maneuver training.

Since it was at the level of the field hospital that the most crucial and exacting surgery would be performed, the most practical solution of the problem presented by the lack of training of these hospitals was to reconstitute them.

Partly trained or trained surgeons were detached from them and transferred to evacuation hospitals or surgical teams, in which they would work under supervision. They were replaced in the field hospitals by trained surgical teams, made up from the staffs of general hospitals or from auxiliary surgical groups (p. 308). This meant that, in effect, the field hospitals were first pulled down and then built up again. The result was a surgical hospital in which the best surgical talent in the army was utilized to the fullest advantage.

In the field hospital, shock teams prepared the casualties for surgery, and surgical teams (p. 308) performed the necessary surgical procedures. The greatest efficiency was usually attained by employing one shock team and one surgical team on each 12-hour shift. Organic personnel of the field hospital platoon assisted in preoperative and postoperative care and were responsible for administrative duties. The qualities of leadership possessed by the platoon commander were extremely important in maintaining harmony and promoting efficiency.

Soon after the Third U.S. Army became operational, it became evident that field hospital platoons set up adjacent to division clearing stations would not be able to move forward with clearing companies because of the nontransportable patients occupying the beds after surgery. This dilemma was solved by attaching the personnel and equipment of an army collecting company to each field hospital platoon. These companies were designated as holding units. When it became necessary for the field hospital platoon to move forward, all nontransportable patients were left in charge of the holding unit. The patients were evacuated as soon as they became transportable, after which the holding unit rejoined the field hospital platoon.

This proved a very efficient plan. Few or no organic field hospital personnel had to be left behind with the holding unit, and very little equipment was necessary. The efficiency of the holding unit personnel was naturally greatly increased if the unit had worked previously with the field hospital and had an understanding of the care required by patients with various types of wounds.

Evacuation Hospitals

While field hospitals accomplished the saving of an incalculable number of seriously wounded battle casualties who required immediate surgery, evacuation hospitals also handled their share of heavy surgery, especially when they were located close to the frontlines and the flow of casualties was heavy. In addition, these hospitals cared for an enormous volume of less seriously wounded battle casualties, many of whom were returned to duty.

The rapid treatment of battle casualties and the return of soldiers to duty within the army area required a well-balanced staff in the evacuation hospital, headed by a chief of surgery who had both sound surgical judgment and administrative ability; the latter was quite as important as the former in the care of wounded men at this echelon.

Evacuation hospitals in the Third U.S. Army were found to operate most efficiently when they were organized to staff 8 or 10 operating tables around the clock, day in and day out. The organic personnel of the hospital was not sufficient, however, to provide the two 12-hour shifts required to maintain such a schedule for any sustained period of time. It had been demonstrated early in the campaign in Europe that the efficiency of a surgeon in an evacuation hospital was definitely reduced if he worked longer than 12 hours at a time. His fatigue manifested itself in a lower standard of work as well as in his total achievement. A 12-hour period of relief provided sufficient rest for him to continue to work hard for long periods.

The solution of this problem was the use of auxiliary surgical teams during the periods of peakloads, which were usually immediately after the hospital had been set up in a forward sector. The minimum requirement was two general surgical and two shock teams. The addition of these teams to the organic personnel of the hospital permitted efficient functioning and prevented surgical backlogs from pyramiding.

The Medical Section, Third Army headquarters, had a very tightly integrated system of communication concerning, and control of, the casualty flow into evacuation hospitals. The system did not attain its full efficiency until the end of the first week of Third U.S. Army operations, and there were, of course, occasions on which it was more efficient than others. Such subordinate units as the medical group with its very specialized facilities and with the excellent signal communication which was almost constantly available, played a major role. Organization and constant supervision were necessary to achieve control of the flow of casualties into evacuation hospitals, but the results were so satisfactory that few persons outside of those intimately concerned with them realized how well the measures which were adopted to achieve these results were working.

The surgical consultant was kept fully informed of the casualty situation; his office in the forward echelon received daily reports of the number of casualties admitted to each evacuation hospital, together with information on the surgical backlog and on the distribution of surgical teams. There were many instances in which this liaison proved extremely valuable.

The organic transportation of evacuation and field hospitals was not sufficient to move evacuation hospitals completely from one location to another, though moves were frequent. During August 1944, for instance, these hospitals averaged about four moves each, the distances ranging from as little as 10 miles to as much as 100 miles. Before the campaigns in Europe started, the Medical Section, Headquarters, Third U.S. Army, had been advised that additional transportation could be obtained as necessary from quartermaster truck companies. As soon as operations got under way, it was evident that this source of transportation would not be available; General Patton commandeered all trucks and other available extra transportation to move petroleum products and ammunition.

The Operations and Training Subsection of the Medical Section solved this difficulty by setting up a provisional truck unit consisting of all available trucks from the medical units under Third U.S. Army control. A chart was maintained, and enough trucks were dispatched to meet the particular needs of evacuation and field hospitals whenever they were obliged to move.

Estimates indicate that about 48 percent of all casualties handled in Third U.S. Army evacuation hospitals were returned to duty in the army area. They were practically always sent back to duty in their original units. Getting personnel back to their own units, as mentioned elsewhere, was as much a must in General Patton's command as was neatness in dress. He recognized the tremendous morale factor for both officers and enlisted men inherent in this plan. No directive was written on the subject, but seeing that this particular policy was adhered to accounted for one important segment of the duties of the surgical consultant.

Auxiliary Surgical Groups and Surgical Teams

The teams of the 4th Auxiliary Surgical Group, which functioned under the Third U.S. Army during the whole period of combat on the Continent, contributed greatly to the high standard of surgical care achieved in this army. For the most part, the chiefs of the various teams were well trained in their specialties before they entered service. Although they lacked actual experience in the handling of battle casualties, their previous training permitted them to adapt their talents rapidly to the exigencies of wartime situations, and their surgical techniques left little to be desired.

A single auxiliary surgical group, even though it consisted of 64 teams, was not sufficient to care for the casualties of an army which often had from 12 to 15 divisions in action. When the teams of the 4th Auxiliary Surgical Group proved insufficient for the necessities of special situations, additional teams were requested. They were provided either from the 1st and 5th Auxiliary Surgical Groups or by temporarily attached teams made up of qualified personnel from general hospitals not active at the time.

The field hospital platoons attached to each division clearing station (p. 306) had to be staffed according to the immediate combat necessities. The number of surgical teams functioning in any one unit thus varied with the number of casualties who had to be cared for at the particular time. Surgical teams and shock teams were most usefully employed in field hospitals (fig. 48). As a rule, two general surgical teams and two shock teams were attached to each field hospital platoon in operation. When casualties were very heavy, they were supplemented by additional teams, which remained only long enough to reduce the existing surgical backlog.

The organic personnel of an evacuation hospital, as just pointed out, no matter how well qualified they might have been, could not cover the needs of such an organization over a 24-hour period in which battle casualties were often admitted at the rate of from 100 to 150 per day. For most efficient operation,

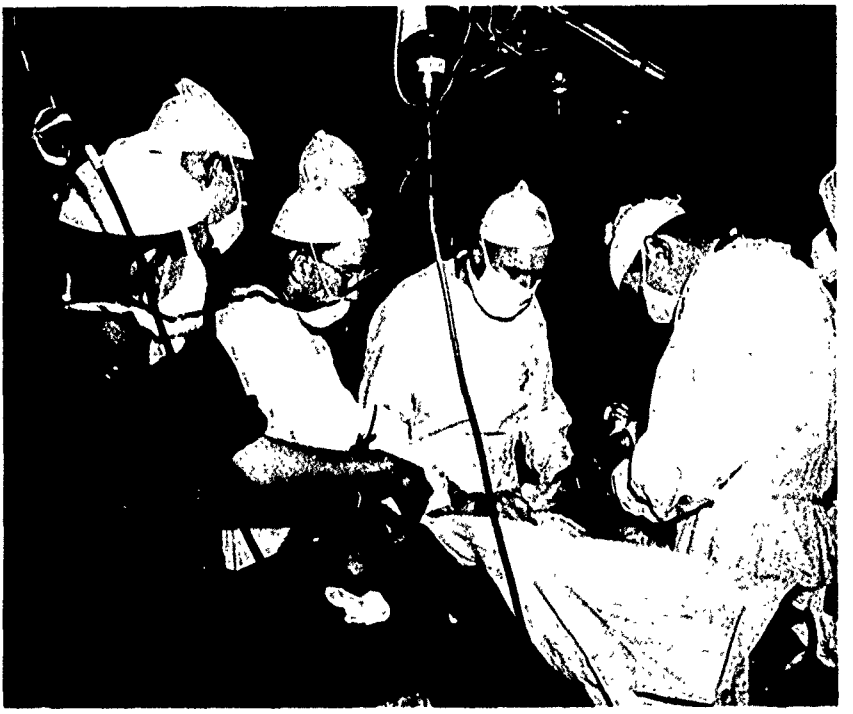


FIGURE 48.—An auxiliary surgical team operating with a field hospital platoon.

an evacuation hospital required the assistance of two general surgical teams, one orthopedic surgical team, one neurosurgical team, and one maxillofacial team. The specialty teams usually covered the 12-hour period which would have remained uncovered if there had been available only the single qualified representatives of these specialties on the organic hospital staff.

Specialty teams functioned best at this level. This was because the great majority of casualties with extremity wounds, head injuries, and maxillofacial injuries were readily transportable and could be moved 15 or 30 miles, or farther, behind the lines to the area in which evacuation hospitals were set up.

Surgical teams were also of great value in bridgeheads across rivers. In these circumstances, the wounded could not readily be evacuated. Even when troops were on the offensive, it was found that definitive surgery could be accomplished by these teams much farther forward than had previously been realized.

The best medical support for armored divisions was provided by the use of a unit staffed by two surgical teams and two shock teams. The necessary tentage, surgical equipment, and other supplies could be moved in two trucks. A unit of this kind would move along with, and be set up next to, a company of the medical battalion of an armored division. A field hospital platoon followed this unit, taking over the casualties who had been operated on and

leaving the surgical teams free to move forward again with the armored division.

Assignments of surgical teams were always so arranged that a few teams were held in reserve, to throw into areas in which unexpected needs might arise. This system also permitted periods of rest for teams which had been working under pressure for long periods of time.

One of the chief points which had been stressed to teams of auxiliary surgical groups when they first began to function in North Africa was that they must operate in harmony with the organic personnel of the hospital units to which they were assigned. In the first days of combat in France, there was some friction between the teams and the hospital staffs, but it promptly disappeared as the help which could be provided by the teams became evident. In the few cases in which personality difficulties developed or persisted, it was a simple matter to switch the team assignments.

The constitution of field and evacuation hospitals and their supplementation by auxiliary surgical group teams illustrate the cooperation which existed within the Third U.S. Army. The executive officer, Col. John Boyd Coates, Jr., MC, was responsible for the location and setup of these hospitals, but, with his full cooperation, all shifting of surgical teams was carried out through the surgical consultant, who made his decisions from his knowledge of the status of the hospital (that is, the number of casualties admitted and the surgical backlog) and of the capabilities of the available teams. The office of the army surgeons was kept informed of all movement of the teams, and assignments were accomplished without friction or other difficulties because of the cooperation of the army surgeon and his executive officer. The information which the surgical consultant obtained, usually by on-the-spot observation at points at which heavy casualties were expected, was acted upon immediately, and the need for additional help, of the precise quantity and quality needed, was often met within a matter of hours. As a result, the highly specialized personnel of auxiliary surgical group teams was used in the most effective manner possible.

During the Battle of the Bulge, in December 1944, information was received at Third Army headquarters that many casualties were piling up in Bastogne, Belgium, and that help was needed to care for them because the medical units attached to the 101st Airborne Division were completely exhausted (fig. 49). A volunteer surgical team, consisting of five medical officers and five Medical Department enlisted men, was formed from the personnel of the 12th Evacuation Hospital, which was then located in Nancy, France. This team, with sufficient medical supplies, was transported to Thionville and then was flown into Bastogne by glider. This was about 36 hours before the Allied breakthrough and the relief of the besieged forces by the advanced element of the 4th Armored Division. The surgical consultant, who entered Bastogne with these troops, was able to assess the casualties at firsthand and to direct their treatment and evacuation.



FIGURE 49.—Two members of the 101st Airborne Division drag badly needed medical supplies which were airdropped to the besieged at Bastogne, Belgium.

SUPPLIES AND EQUIPMENT

Medical supplies and equipment were of the best quality and were provided in adequate quantities, so that all the units which landed in France after D-day were fully equipped. This was generally true through the whole period of fighting. In addition, at intervals, U.S. Army equipment was supplemented by captured equipment. During August 1944, for instance, more than 200 tons of German medical supplies were captured. About a third of this material could be used by U.S. Army medical units and was channeled accordingly.

During the 3 months before the Third U.S. Army was committed on the Continent, the various medical units drew their equipment, and their personnel became acquainted with its use. The cooperation of Col. Elliott C. Cutler, MC, Chief Consultant in Surgery to the Chief Surgeon, ETOUSA, made it possible to augment the equipment supplied by tables of equipment with certain other items which had been found in the Mediterranean theater to be useful and often to be necessary for the proper functioning of various units. These items included additional anesthesia machines; generators for electric-light plants; and nonstandardized supplies for certain technical procedures, such as Vitallium tubes for blood vessel anastomosis and fibrin foam and other items used in neurosurgical procedures.

During the orientation course in England before D-day, various improvisations and alterations in the routine use of equipment were demonstrated because

they had been found to be of value in Africa, Sicily, and Italy. One of these demonstrations concerned the setting up of tentage so that the central supply unit was really central. The supply tent was set up at the center of four operating tents, which branched off from it in cruciform fashion. The original plan had been for the dispersion of all such facilities. The substitute plan simplified heating, reduced the number of personnel needed, reduced the time necessary to secure supplies, and made it necessary for personnel to face mud, rain, and snow in order to get them.

PROFESSIONAL MEETINGS

Because of the pressure of events, no medical societies were organized in the Third U.S. Army, and no regularly scheduled conferences were set up. Several times, however, during lulls in military operations, representatives of the surgical staffs of field and evacuation hospitals were summoned to meet at some central point for the discussion of problems of general concern. These conferences were of great benefit. Medical officers, from the beginning, had been encouraged informally to record experiences of special interest, and many of them were presented at these conferences.

Conferences arranged by the theater consultants were also of great value. They kept everyone posted on routine and special practices, especially advances in the treatment of casualties, and provided a useful forum for the exchange of ideas. Officers who had become interested in special clinical problems were asked to present them at these meetings. The substance of the discussions and the conclusions arrived at were passed along to the surgical teams and hospital staffs by the surgical consultant.

Colonel Odom also attended several meetings of the medical staffs of all Allied armies. One of these meetings, held in Paris two months after the invasion of the Continent, was particularly helpful because of the opportunity afforded for the evaluation of the work of forward units. It was gratifying to hear only minor criticisms from the hospitals in the communications zone. When Colonel Odom returned from another of these general meetings, which was held in Brussels in December 1944, he reached Third U.S. Army headquarters by passing through the area in which the Battle of the Bulge was to erupt only 24 hours later.

Time and events did not permit formal publications from the Third U.S. Army, but Colonel Odom made a personal study of amputations and vascular injuries in the Third U.S. Army and reported the analysis at one of the Inter-Allied Conferences on War Medicine convened by the Royal Society of Medicine in May 1945[3] (p. 324). A supplementary report on the same subject was published in *Surgery* in 1946.[4]

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[3] Odom, Charles B.: Vascular Injuries in Battle Casualties. *In* Inter-Allied Conferences on War Medicine, 1942–1945. London: Staples Press Limited, 1947, 167–171.

[4] Odom, C. B.: Causes of Amputations in Battle Casualties With Emphasis on Vascular Injuries. Surgery 19: 562–569, April 1946



FIGURE 50. Nazi hospital unit surrenders in Germany.

RECORDS

The records kept in all hospitals of the Third U.S. Army were regularly examined by the surgical consultant in frequent spot checks, and their importance was stressed whenever a hospital was visited. The constant emphasis upon these matters resulted in consistently good records, even when the units were extremely busy.

Almost all hospitals kept their records in duplicate. The original was sent with the patient when he was evacuated, and the carbon was retained. This system had the advantage of maintaining a continuous record of all patients handled in each hospital, and it also permitted medical officers assigned to the unit to review the cases which they had handled personally.

PRISONERS OF WAR

During the early months of the campaigns in Europe, when only German field medical units were captured, wounded enemy casualties were evacuated through normal U.S. Army channels of evacuation. As the Third U.S. Army advance continued, ever increasing numbers of German military hospitals were uncovered (fig. 50). A directive was issued on 11 April 1945 defining the specific responsibilities of the army medical service in regard to these installa-

tions.[5] German prisoners of war uncovered on the field of battle and requiring prompt care were to be treated and evacuated through normal medical channels. Those uncovered in German military or civilian hospitals were to be managed by a "stay put" policy, the tactical situation permitting. Battlefield enemy casualties who did not require immediate care were to be sent to these hospitals. When the casualties were ready for discharge from the hospital, they were to be sent to prisoner-of-war enclosures.

Consolidation of German patients in military or civilian hospitals was accomplished whenever the circumstances permitted, and maximum use was made of German medical department supplies and equipment. Medical supplies, as far as possible, were replenished from captured German stocks. Whenever possible, German medical officers were left in charge of these intact hospitals, but administrative details were provided by U.S. Army medical units.

The surgical consultant visited the prisoner-of-war hospitals and saw to it that the treatment instituted was commensurate with U.S. standards of medical practice.

One morning, shortly after the German surrender, Colonel Odom was instructed by General Patton to examine Field Marshal Karl von Rundstedt; he had been captured and was housed in a small resort town with his personal German physician, who contended that he was too ill to be moved. Colonel Odom found him in excellent physical condition except for a mild hypertension. A few hours after this report had been given to General Patton, Field Marshal von Rundstedt was on his way to a prisoner-of-war camp in England.

Section II. Clinical Considerations

DISSEMINATION OF CLINICAL POLICIES

In addition to the Manual of Therapy, European Theater of Operations, issued in May 1944, surgical policies in the Third U.S. Army were chiefly determined by the second (surgical) part of the medical plan which formed Annex 16 to the Third U.S. Army Plan for Operation OVERLORD, dated 11 May 1944. These Third Army surgical policies were revised by a directive published on 13 October 1944.[6]

The surgical consultant prepared the directives pertaining to surgery which emanated from Third U.S. Army headquarters, insuring that they conformed with the appropriate directives from the Office of the Surgeon General and the Office of the Chief Surgeon, ETOUSA. After a directive had been issued, the consultant ascertained, on his next visits to army units, that it was fully understood and was being followed.

As a matter of convenience, as well as to point up the changes in policies, the surgical policies set up in May 1944 and revised in October 1944, after 3 months of combat, are described together.

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[5] See footnote 1(2), p. 291.

[6] Annex No. XIV, After Action Report, Office of the Surgeon, Third U.S. Army, 15 May 1945.

GENERAL CONSIDERATIONS OF FORWARD SURGERY

In the Third U.S. Army medical plan for Operation OVERLORD, dated 11 May 1944, it was pointed out that early, skilled surgical care of battle casualties is the principal function of medical installations supporting a field army. This care was based on the following principles:

1. First aid and primary care include only dressing of wounds, control of hemorrhage, splinting of fractures, and treatment of shock. These measures are carried out at battalion aid stations and at collecting and clearing stations.

2. Definitive surgery is not to be undertaken in installations forward of field hospital platoons.

3. A most important consideration in the early care of the wounded is the proper sorting of casualties. This sorting (triage) permits lightly wounded to be returned quickly to duty, while seriously wounded casualties are evacuated to field or evacuation hospitals, the echelon at which they are treated depending upon their transportability.

In this medical plan, casualties were divided into two groups, as follows: (1) A transportable group, consisting of those who could withstand movement to the rear without deterioration; and (2) a nontransportable group, consisting of casualties who would do poorly when moved and whose wounds (or the status resulting from whose wounds) required immediate treatment.

There were a number of categories in the nontransportable group, as follows:

1. Casualties, usually those with multiple wounds, who remained in shock in spite of intensive resuscitative therapy.

2. Casualties with abdominal wounds, particularly those with possible concealed hemorrhage. In evaluating these patients, it was emphasized that another fact had to be taken into consideration, that all previous experience had shown that patients who had undergone laparotomy could not be safely moved for at least 7 or 10 days. In other words, the triage of this group required the evaluation of both the postoperative circumstances and the casualty's present status.

3. Casualties with large sucking chest wounds or massive intrathoracic hemorrhage.

4. Casualties with transthoracic or thoracoabdominal wounds. It was pointed out that these wounds are difficult to diagnose and are likely to be missed because the path of the missile is frequently unexpected. In wounds of the buttocks, for instance, the missile may come to rest in the thorax, while in wounds of the shoulder, it might lodge within the peritoneal cavity. If X-ray facilities were available, it was recommended that they be used to settle the matter.

5. Casualties with wounds about the face and neck causing mechanical interference with respiration. Patients in this category would usually require tracheotomy before evacuation.

SHOCK AND RESUSCITATION

Shock was the most important cause of death in casualties who did not die immediately of their wounds. If it was not treated promptly and vigorously, it was likely to become irreversible. Its prolongation, even if the patient did not die immediately, often led to a subsequent fatality from anuria. Among the casualties who died in anuria, prolonged, profound shock seemed to be the single constant factor; transfusion reactions did not seem of great importance in this connection. Alkalinization and other methods were found to be of no value in either the prevention or the treatment of this complication. The important consideration was to bring the casualty promptly out of shock.

Adequate shock therapy, based on the use of plasma and stored whole blood, was probably the most important single method of lowering the mortality and morbidity from combat wounds. Operation was performed as soon as possible after resuscitation and was regarded as part of the resuscitative routine.

Teams were set up in all forward hospitals for the treatment of shock and the administration of blood. The chiefs of laboratory services were responsible for the supervision of the hospital blood program.

Plasma was available to all medical units as far forward as battalion aid stations. It was used in liberal quantities in the prevention of shock and in resuscitation until a field hospital could be reached. It was of value, however, only as a temporary expedient. No casualty could be properly prepared for surgery without the use of whole blood. Plasma and whole blood were originally used in the proportion of 2 pints of plasma to 1 pint of blood, but, as the campaign progressed, more and more blood was used.

Before D-day, the policy was formulated that the Third U.S. Army would have attached to it a blood bank detachment for the receipt, storage, and delivery of whole blood. The blood was to be delivered daily to all hospitals on a so-called "milk run." Plans were also made, and hospitals were equipped, to obtain whole blood from hospital personnel.

These plans were based on the provision of blood by the theater blood bank in the United Kingdom Base. During initial operations, 190 pints were delivered daily for the use of the whole Third U.S. Army. This supply was entirely inadequate, even with supplementary provision of whole blood secured by bleeding hospital personnel. Late in August, supplies from the Zone of Interior became available, and from 500 to 700 pints of blood were received daily. This was an entirely adequate provision. There was only one occasion thereafter on which whole blood was badly needed and was not available in sufficient quantities. Colonel Odom was dispatched by the army surgeon to theater headquarters, then in Paris, and a conference with Maj. Gen. Paul R. Hawley, Chief Surgeon, ETOUSA, and General Cutler, his consultant in surgery, insured an adequate supply for all immediate needs and future necessities.

The blood was delivered in refrigerated trucks and stored at a temperature of 35° to 40° F. (approximately 2° to 4° C.). All blood which had passed the

expiration date marked on the bottle or which had been allowed to become warm was discarded; warming involved the risk of hemolysis, and all transfusions were made with cold blood.

Final statistics for the Third U.S. Army blood-plasma program show that 4,826 transfusions were accomplished with fresh whole blood, 39,529 with stored whole blood, and 56,957 with dried plasma. Other blood substitutes were used 1,834 times.

ADMINISTRATION OF MORPHINE

Because of the early experiences in the Mediterranean theater, morphine was used more cautiously in the European theater. In Italy, it had been found that the repetition of a dose of morphine, even when the original dose did not seem effective, was extremely dangerous and could lead to morphine poisoning. The explanation was that absorption of the original amount was at first inhibited by cold and damp, as well as by high altitudes, but was facilitated when the patient was brought into a warm environment, or a lower level. If the original dose had been repeated, both doses were absorbed with dangerous rapidity.

When morphine was indicated, a dosage of one-quarter of a grain (15 mg.) was usually adequate, although occasionally one-half grain (30 mg.) was required for the control of pain. Larger doses were never repeated. The time and amount of the injection were always recorded.

Morphine was administered subcutaneously or intramuscularly if a gradual, prolonged effect was desired and intravenously if a rapid effect was desired. Intravenous injection was in the amount of one-sixth of a grain (10 mg.). Massage at the site of intramuscular or subcutaneous injection hastened absorption.

ANTIMICROBIAL THERAPY

Chemotherapy.—In the Third U.S. Army medical plan for Operation OVERLORD, soldiers wounded in action were directed to take, by mouth, 4 grams of sulfadiazine in tablet form from their first aid package as soon as possible unless the wounds involved the abdomen. At least half a canteen of water was to be drunk within the next 5 or 10 minutes.

The medical officer who first dressed the wound was instructed to frost it lightly with sulfanilamide powder. The powder was available in 5-gm. packets, and, under no circumstances, regardless of the size and number of his wounds, were more than two packets (10 gm.) to be used for a single casualty.

Sulfadiazine by mouth was to be continued until definitive surgery had been accomplished. The maintenance dose was 1 gm. orally every 4 to 6 hours or 2 gm. parenterally every 8 to 12 hours. After debridement, or after definitive surgery, all wounds were again lightly dusted with sulfanilamide powder, and sulfonamide therapy was also continued by the oral or parenteral route.

Medical officers were instructed to be constantly on the alert for a possible reaction to the sulfonamide drugs If a reaction occurred, the medication was

to be discontinued entirely or continued in decreased dosages and under strict observation.

By the time the May 1944 medical plan was issued, the experience in the Mediterranean theater had shown that the sulfonamide preparations in a wound act as foreign bodies. The local use of sulfonamides was therefore discontinued entirely within a few months after the invasion of the Continent. They were found to be of no therapeutic value, and wound healing was actually delayed when crystals were used. Local reactions were not uncommon, and after the wounded man had resumed his activities the wound sometimes broke down.

Antibiotic therapy.—Penicillin was available for general use in military hospitals when the Third U.S. Army became operational. It was administered parenterally in clearing stations, and the same regimen was continued in field and evacuation hospitals. The administration of penicillin by the parenteral route, combined with early, adequate debridement, was regarded as the most important single contribution to the low incidence of wound infection reported in Third U.S. Army hospitals. If local therapy was employed, it was instituted in the field or evacuation hospital in which definitive surgery was performed.

The dosage of penicillin, as well as the time of administration and the route (parenteral or local), was recorded in units on the emergency medical tag and the field medical record. In spite of repeated spot checks and constant emphasis upon the importance of these notations, these instructions, unfortunately, were not always carried out.

WOUND MANAGEMENT

In all instruction of Third U.S. Army medical personnel, as well as in the medical plan issued in May 1944, it was emphasized that all battle injuries must be debrided and that debridement was the most important single phase of correct surgical care. The operation was to include removal of minimal amounts of skin but of maximal amounts of devitalized tissue, as well as thorough mechanical cleansing to remove all dirt, debris, and readily accessible foreign bodies; foreign bodies at a distance from the wound were to be left in situ. After debridement had been performed in a forward hospital, the wound was to be left unsutured, with the edges kept separated by strips of petrolatum-impregnated gauze. Tight packing of the wound was to be avoided, since a pack acts as a plug and invites infection.

It was often extremely difficult to make medical officers fresh from civilian life realize the importance of radical debridement in battle-incurred injuries. In the directive issued in October 1944, emphasis was again placed on the necessity for the wide excision of all damaged muscle, the thorough mechanical cleansing of wounds, and the removal of minimal amounts of skin. Particular stress was put on adequate incisions. The circular excision of skin around small wounds was specifically forbidden; this technique resulted in prolongation of the convalescence and made delayed primary wound closure very difficult.

Although the first principle of military surgery was to debride the wound and leave it open, it was equally essential that closure be effected as promptly as possible, to limit infection—the incidence of which was remarkably low—and fibrosis and to facilitate the casualty's return to duty.

If primary debridement had been adequate, wounds could usually be closed as early as the third day after operation, though it was preferable to leave them open for another 24 or 48 hours. Whether a wound could be safely closed or should be left open for a longer period was a clinical decision, which was not made until the debrided wound was uncovered in the operating room. Preliminary inspection and repeated dressings were avoided, on the ground that these procedures invited contamination.

Closure was considered safe in the absence of such signs of inflammation as discharge, reddening, pain, and swelling. The wound edges were brought together loosely, without undermining of the edges. Sharp instruments were avoided. Retention sutures, which were of silk or silkworm gut, were spaced widely and tied loosely.

If mild infection was apparent in the debrided wound, hot moist dressings were applied before closure was undertaken. Healing was usually prompt. If evidences of infection became apparent in a wound after delayed primary closure, immediate removal of the sutures was indicated.

REGIONAL INJURIES

Bone and Joint Injuries

Wounds of the extremities (table 3) accounted for more than 61 percent of the battle-incurred injuries treated in Third U.S. Army hospitals between 1 August 1944 and 30 April 1945. The majority of these injuries involved bones, joints, or both.

Fractures.—In the initial surgical plan, directions were given that all compound fractures be debrided and left open and that the injured limbs be immobilized in splints or plaster casts before the casualty was transported to a hospital in the communications zone.

No external or internal plating or other fixation was permitted in field or evacuation hospitals of the Third U.S. Army. Definitive reduction of fractures was not regarded as the mission of forward hospitals. In the October 1944 directive, it was again emphasized that field and evacuation hospitals were responsible for the debridement of compound fractures, transportation splinting, and preparation of the patient for early evacuation in comfort and safety but for nothing else in bone and joint injuries.

When plaster of paris casts were used, circular bandages or other circular dressings were not used under them. All casts were padded. All circular casts were split through all layers, including the layer of wadding, down to the skin. Casts on the lower extremity were split from the tips of the toes to well above the knee. Casts on the upper extremity were split from the tips of the fingers

to above the elbow. This precaution was taken in the operating room, as an integral part of the surgical procedure.

Thomas' full-ring or half-ring splints were permitted only in emergencies in forward medical installations. They were replaced as soon as possible by plaster of paris circular splints.

Regional splinting.—Instructions for immobilization in the October 1944 directive were more specific than in the May 1944 plan. In accordance with the October directive the procedure was as follows:

1. Fractures of the humerus were immobilized by plaster of paris spica bandages. The arm was held forward and rotated medially, so that the forearm was in front of the body. The elbow was flexed at least 90°. A plaster of paris Velpeau's bandage was less satisfactory than a spica, and hanging casts were prohibited.

2. Fractures of the forearm, wrist, and hand were immobilized by circular plaster of paris casts extending to the midbrachial region. A cast applied to the forearm and hand was cut back to the proximal palmar sulcus, to permit free and unimpeded motion of the fingers, except in injuries of the metacarpals or phalanges. Then the cast was extended to the tips of the fingers.

3. Fractures of the femur were immobilized in a double circular plaster of paris spica extending from the toes of the affected leg and from just above the knee of the sound leg to the pelvis. The spica was reinforced by a posterior strut, and the legs, with the knees slightly flexed, were spread apart, the separation being gaged to the width of the litter. The use of the Tobruk splint was permitted in selected fractures of the femur.

4. Fractures of the tibia and fibula were immobilized in circular plaster of paris bandages extending from toes to groin. The foot was placed in neutral position at a right angle to the leg.

Joint injuries.—Wounds of the joints were treated, as soft tissue wounds were treated, by debridement, with removal of all foreign bodies and devitalized tissue within the joint. Closure of the joint was essential, though the soft tissue wound was left open, as in the usual debridement. Penicillin solution was instilled into the joint immediately after closure.

Hand Injuries

By the time the October 1944 directive was issued, the dangers of prolonged immobilization in hand injuries had become fully evident, and much emphasis was therefore placed upon them. The objective in all hand injuries was early, active motion, which was militated against by prolonged immobilization.

The policy was to treat all injuries of the hand as soft tissue injuries. Special efforts were made to close the wound promptly by suture or skin graft.

When tendon and bone fragments were exposed, the patient was transferred as promptly as possible to the nearest plastic surgery center.

Amputation was performed only in the most extreme cases, and then at the most distal point possible. There was one exception to this generalization, as follows: In compound fractures of the distal portion of a finger, accompanied by destruction of the flexor and extensor tendons, the digit was amputated promptly, and early, active motion of the remaining fingers and the entire hand was practiced.

In selected cases, when skeletal traction was necessary to secure reduction and immobilization of metacarpal fractures, it was applied through the proximal phalanges. Again, there was emphasis on early active motion; immobilization was permitted for no longer than 2 weeks. The intact phalangeal and metacarpophalangeal joints were left free. Pulp traction was never permitted.

Maxillofacial Wounds

In the May 1944 medical plan, it was emphasized that wounds of the face must be treated with special care at debridement. Excision should be as conservative as possible, and as much as possible of the skin, muscle, bone, and cartilage should be preserved.

These instructions were expanded in the directive issued in October 1944. If it was thought that the missile had penetrated the nasal mucosa, a complete preliminary examination was conducted, to determine possible internal damage. If the nasal mucosa was injured, the cavity was packed with gauze strips impregnated with a sulfonamide drug ointment, to insure healing on both surfaces of the mucosa and to prevent closure of the airway by adhesions. The gauze, which protruded from the nostril, was replaced every 5 or 10 days.

Before a patient with a nasal injury was evacuated, a thorough examination was made, to insure that the nasal airway was open. If adhesions were found, they were severed, and the nostril was again packed, to prevent their re-forming.

Abdominal Injuries

The importance of colostomy in wounds of the colon and rectum was a lesson which had been learned in the Mediterranean theater by painful experience and which was emphasized throughout the campaigns in Europe.

Whenever possible, when the double-barreled type of colostomy was employed, the large intestine was mobilized to permit approximation of 2.5 or 3 inches of bowel within the peritoneal cavity. When loop colostomy was employed, the initial opening seldom exceeded an inch in length. The incision was made in the region of the presenting taenia, parallel to the long axis of the bowel. It was emphasized that in injuries of the rectum or the sigmoid the bowel must be severed in order to secure complete interruption of the fecal stream below the site of the colostomy.

Neurosurgical Injuries

Spinal injuries.—Compression fractures of the spine were reduced by hyperextension, and a plaster of paris jacket was applied while the patient was still in this position. In fractures of the lumbar or lower dorsal vertebrae, the jacket extended from the symphysis pubis to the sternal notch. In cervical and upper dorsal fractures, the head was included in an extension of the jacket.

Gunshot wounds causing fractures of the spine and damage to the spinal cord were treated in evacuation hospitals, where the extent of the injury could be determined by the combined efforts of the orthopedic surgeon and the neurosurgeon. If surgery was required and operation would be possible within 36 hours of injury, the patient was immediately evacuated to the nearest general hospital in the communications zone. If this was not practical, exploratory laminectomy was carried out by the neurosurgeon in the evacuation hospital; the exploration was undertaken whenever there was any doubt that the cord was completely severed. Transportation of patients with spinal cord injuries in plaster was prohibited.

If the patient with a spinal cord injury could not void, he was catheterized, and the catheter was left in situ. Tidal drainage was instituted as soon as possible and was continued until complete neurologic evaluation was possible. Special care was taken to insure that the bladder was emptying completely. After this evaluation, tidal drainage was continued if there was evidence of early bladder recovery.

Early high suprapubic cystostomy was recommended if bladder recovery was not promptly evident in cord bladder secondary to permanent cord damage. A large mushroom or Malecot catheter was used and was changed frequently, to prevent infection and incrustation. Daily bladder irrigations were also practiced.

Peripheral nerve injuries.—Nerve damage was sought for in all injuries of the extremities, even if the lacerations were slight. The objective in all peripheral nerve injuries was early repair at a specialized neurosurgical center. Primary repair was not undertaken in hospitals of the Third U.S. Army; the established technique was delayed repair, within 21 to 90 days after wounding and after complete healing of the soft tissue wound.

Exposed nerves were, however, never left exposed in a forward hospital. Whether or not they were found to be injured at debridement, they were covered by fascia, muscle, or both. The severed ends of a damaged nerve were frequently loosely approximated by one or two nonabsorbable sutures, to prevent retraction. If the defect was so extensive that this was not possible, the severed ends were marked by single nonabsorbable sutures.

Vascular Injuries

All surgeons of the Third U.S. Army were thoroughly indoctrinated with the importance of attempting repair of vascular injuries, since in their repair lay the greatest possible chances of salvage of limbs.

The Vitallium tubes and heparin necessary for a large-scale application of the nonsuture technique of vascular anastomosis were not available in large quantities, but sufficient supplies were available to permit a fair trial of the method. Glass or plastic tubes were used in a few cases in which Blakemore tubes were not available. Reports by Blakemore and other vascular surgeons on the nonsuture repair of blood vessels were reproduced, and copies were placed in the hands of every chief of surgery and every chief of a surgical team.

It was the consensus that these procedures were usually impractical for general use in the field, for the following reasons:

1. Recognition of injury to a blood vessel was essential for successful application of repair techniques. Diagnosis could not be expected of the corpsman who first cared for the casualty on the battlefield, and even if he should recognize the injury he could not institute therapy. Civilian surgeons who repeatedly recommended the repair of vascular injuries during the war failed to take into consideration the limitations of first aid men and the conditions under which they worked.

2. A major part of the discrepancy between the results in vascular injuries encountered in civilian life and those encountered in military practice could be explained by differences in the timelag. The lapse of time between wounding and surgery is seldom excessive in civilian practice. In World War II, the timelag averaged, at the best, between 6 and 12 hours.

3. There were other differences between civilian and military practice. The battle casualty, in contrast to the civilian patient, who usually was in good condition, was often exsanguinated and in shock. The battle casualty's blood pressure was low. His tissues were anoxic. There was often hemorrhage into the fascial planes of the injured extremity, with resulting hematoma formation and pressure on the collateral circulation, which itself was often injured. The disappointing results of sympathetic block, which was used routinely before and after vascular surgery, could frequently be accounted for by these conditions rather than by badly performed blocks.

4. The preparation of fresh vein grafts was too time consuming to be generally undertaken in military practice. Had frozen grafts been available, another objection to the repair of combat-damaged blood vessels might have been removed.

5. Heparin must be used to prevent clotting at the site of repair in all nonsuture techniques of vascular anastomosis. This measure, however, would have been attended with considerable risk, for a third or more of all casualties with vascular injuries had multiple wounds. Fatal hemorrhage occurred for this reason in a number of patients who had been heparinized.

6. The institution of surgical procedures in the battalion aid station, where only resuscitation and first aid measures were employed, would have required the revision of the entire system of management of casualties in forward areas. This might have been justified if there had been large numbers of casualties with vascular injuries susceptible of salvage. The lives of other casualties

could not justifiably be imperiled, however, for a group of casualties who constituted less than 1 percent of the total number of wounded.

Analysis of cases.—A single laceration or a single puncture wound of a major artery was uncommon. Most often, the vascular injury was associated with other injuries.

In 92,030 battle casualties treated in the Third U.S. Army during its entire operational period, only 837, or 0.9 percent, had wounds classified as vascular.[7] This was a much smaller proportion than civilian surgeons might suppose. It is believed that this figure is accurate; because all surgeons were on the alert for vascular injuries, excellent records were kept.

Of these 837 injuries to major arteries, 423 came to amputation. In no case in which removal of the limb was necessary was the operation performed without consultation. In retrospect, it almost seems that conservatism was overemphasized; it is believed that an occasional life was lost in the laudable attempt to save a limb.

Only 70 blood vessels are known to have been repaired in Third U.S. Army hospitals. When these cases are compared with the 592 comparable injuries in which ligation was done, it is seen that gangrene developed in 57 percent of the ligated cases against 38 percent of the cases in which repair was undertaken. The comparison, however, is scarcely valid. One reason is that the repair series is disproportionately small. The second and principal reason is that only the most favorable cases were selected for an attempt at repair, and the comparison of the series is therefore not a comparison of parallel cases. On the other hand, the distinct advantage in vascular repair is evident in this small series and is an indication that the technique should be employed whenever it is practical.

Repair of damaged vessels by suture was always the method of choice, even when it involved reduction of the caliber of the damaged vessel by as much as 50 percent. Only the larger arteries, including the subclavian, axillary, brachial, iliac, femoral, and popliteal vessels, lent themselves to this technique of repair.

Arteriovenous aneurysms and false aneurysms were treated conservatively in forward hospitals. Definitive treatment was usually undertaken in hospitals in the communications zone 6 weeks or more after wounding. In the interval, because of the development of an adequate collateral circulation, gangrene of the extremity seldom resulted.

AMPUTATIONS

There were more amputees in World War II than in World War I, partly because there were more casualties and partly because more men who had lost an arm or a leg lived to return home. The use of more destructive missiles explained the higher amputation rate, particularly the extensive use of land-

[7] See footnote 3, p. 312.



FIGURE 51. Preparation of a mangled arm prior to amputation in a field hospital.

mines, which were practically unknown in World War I. The direct result of injuries from landmines is shown in the study of 1,833 amputations conducted by Colonel Odom,[1] in which there were 1,375 amputations of the lower extremity compared with 458 amputations of the upper extremity.

By far the largest number of amputees observed in the Third U.S. Army, as in other armies, had lost the member immediately upon wounding, or the limb had been so badly mangled that the damage was beyond repair and completion of the amputation was the only practical method of treatment (fig. 51). Sixty-five percent of the amputations performed in Third Army hospitals were for mutilating injuries, which often involved bone, blood vessels, nerves, and soft tissue en masse. Medical officers who treated these patients in forward hospitals knew that no known surgical methods could save these limbs. The picture of a lower extremity hopelessly mangled by an exploding German mine was not visualized by the enthusiasts in the Zone of Interior who believed either that 90 to 100 percent of all amputations could be prevented by sympathetic

[1] See footnote 4, p. 312.

block or sympathectomy or that blood vessel anastomosis would effect a 50-percent reduction in the incidence of amputations for vascular injuries.

In addition to primary trauma, vascular injuries and clostridial myositis provided the chief indications for amputation in World War II. It is noteworthy that the chief cause of amputation in World War I, secondary infection, was practically unknown in World War II, in which it was eliminated by early, adequate debridement, supplemented by chemotherapeutic and antibiotic agents.

Sympathetic block was performed routinely whenever the blood supply was interfered with, but it was not of great value, as a rule, because the collateral circulation was likely to have been damaged also.

Amputation was performed by the open circular technique described in Circular Letter No. 101, Office of the Chief Surgeon, Headquarters, ETOUSA, 30 July 1944. Skin traction was applied to effect closure of the stump.

ANAEROBIC INFECTIONS

Clostridial Myositis

During the operational period of the Third U.S. Army, 445 casualties with clostridial myositis were encountered, of whom 258 came to amputation. Characteristically, wounds which produced destruction of muscle, either directly or by interruption of the blood supply, were particularly susceptible to this type of infection. It was most frequent in wounds of the buttock, upper thigh (in compound fractures of the femur), anterior tibial muscles, shoulder girdle, and short flexors and extensors of the forearm.

In order to prevent unnecessary amputations on the mistaken diagnosis of clostridal myositis, particular attention was paid to the classification of clostridial infections, as follows:

1. Diffuse clostridial myositis. In this condition, amputation was performed immediately, as far as possible above the visible evidence of infection. This type of infection accounted for 14 percent of the total recorded infections, and 15 percent of the amputations, in the Third U.S. Army. The rate of amputation was four times as high in German prisoners of war treated in U.S. Army hospitals. The most reasonable explanation of the difference was the greater delay from the time of injury to surgical care, which was almost inevitable in prisoners and which was sometimes a matter of days. Once the prisoners were received, they had the same treatment as U.S. Army casualties.

2. Clostridial cellulitis involving only a muscle or a group of muscles. In this condition, wide excision of the devitalized local tissue was all that was necessary. Amputation was never indicated.

3. Localized clostridial abscess. Incision and drainage were sufficient. Amputation was never indicated.

When casualties were received early, that is, within 24 hours after wounding, clostridial myositis was seldom a problem. It was preventable, in almost

all cases, by adequate debridement of all wounds, one of the points which the surgical consultant never failed to stress in all visits to all hospitals.

Once clostridial myositis had developed, there was not a great deal to be done about it, though all available measures were employed, including fasciotomy and the administration of penicillin and gas gangrene antitoxin.

The general impression was that gas gangrene antitoxin was of little value, though it was used regularly, in the prescribed doses. The liberal use of penicillin, in dosages much above the ordinary, was also routine, though it was thought that the whole value of this measure was to control secondary infection and that the antibiotic had little effect upon Welch's bacillus.

Amputation was useful if it could be performed distally. If the infection was in the thigh, it was almost never lifesaving.

Tetanus

Tetanus can occur in any wound, regardless of its size and location, and it was quite frequent in prisoners of war. It was practically nonexistent, however, in U.S. Army casualties and in the Canadian casualties handled in U.S. Army hospitals, since the Armed Forces of both nations had been immunized upon entering service.

U.S. Army and Canadian casualties received 1 cc. of tetanus toxoid subcutaneously as soon as possible after wounding. If its administration had not been recorded on the emergency medical tag or the field medical record and the wounded man could not be entirely definite about it, the injection was repeated. An injection in the same amount was given before manipulation or exploration of an old wound.

Wounded Allied soldiers who had not previously been immunized, as well as all wounded civilians, and prisoners of war, were given 3,000 units of tetanus antitoxin intramuscularly. Even though appropriate tests for sensitivity had always been conducted before the injection, a syringe containing 1 cc. of adrenaline (epinephrine) in 1:1000 solution was kept at hand, to be prepared for unexpected reactions.

COLD INJURY

The Third U.S. Army had the unhappy distinction of having in it the first case of trenchfoot to be reported in the European theater. It appeared on 27 August 1944, in a First U.S. Army hospital unit then attached to the Third Army.[9] By 12 October, 25 or 30 cases of trenchfoot had been reported in the 35th Division; some of them, which were attributed to lack of overshoes, had occurred as early as 6 October.

These cases heralded the beginning of a widespread epidemic of trenchfoot in early November and a second epidemic, this time in the form of frostbite, the following month, during the Battle of the Bulge. In each of these epidem-

[9] Annual Report, First U.S. Army, 1944.



FIGURE 52.—Medical troops of the 4th Division bring up equipment, using an assault boat as a sled over wet snow.

ies, the Third U.S. Army had the largest number of cases in the theater. A third epidemic, in February 1945, took the form of trenchfoot.

The story of cold injury in the European Theater of Operations is told in detail in another volume in this series.[10] It need not be repeated here, though it should be said that the Third U.S. Army, which along with the First U.S. Army had the largest number of cases of cold injury in the theater, also had the heaviest and most difficult combat assignments. Both armies also suffered from shortages and actual lacks of proper protective clothing and footgear during the worst of the winter weather. The winter of 1944–45 was the most severe in western Europe in many years (fig. 52).

In addition to the energetic preventive action taken by the Chief Surgeon, ETOUSA, several directives on the subject of the prevention of cold injury were issued from the office of the surgeon of the Third U.S. Army. General Patton's support and participation were characteristically vigorous. He recognized at once that this was a command responsibility and stated unequivocally that the excessive development of cold injury in any organization in the Third Army would be regarded as an indication of inadequate supervision and control.

[10] Medical Department United States Army: Cold Injury, Ground Type. Washington: U.S. Government Printing Office, 1958.

On 21 November 1944, in response to a command directive issued by Lt. Gen. Omar N. Bradley, Commanding General, 12th Army Group, General Patton made the blunt statement that the current menace was not the German Army, which the U.S. Army had practically destroyed, but the weather. General Patton stated further that, if they did not exert themselves, the weather might well destroy them through the incidence of trenchfoot. It is not surprising that when the first epidemic of cold injury began to lessen in intensity, the most precipitous decline in incidence was in the Third U.S. Army.

The question of whether or not the Purple Heart should be given for trenchfoot did not arise in the Third U.S. Army. General Patton simply directed that it not be given.

During the fall and winter of 1944–45, admissions for cold injury required a large bed occupancy in forward hospitals and an enormous amount of medical attention and nursing care. No satisfactory treatment was ever devised, and the medical problems were almost as serious as the losses in manpower. When the overloading of evacuation hospitals with this type of casualty became evident, an Army clearing company was instructed to set up a cold injury facility, to which many patients in the army area were evacuated. This installation, at least to some degree, removed the pressure from Third U.S. Army evacuation hospitals.

In addition, a company of the 94th Medical Gas Treatment Battalion was designated to receive from other Third U.S. Army medical installations certain casualties whose cold injuries were mild. These patients were held for from 10 to 20 days to determine whether they could be returned directly to duty within the army area. In a significant number of cases, this proved possible.

EVALUATION OF SURGICAL CARE

One of the chief responsibilities of the surgical consultant had to do with ways and means of improving surgical care in all forward medical treatment facilities. When he visited a hospital, after he had talked with the commanding officer and the chief of the surgical service, it was this consultant's practice to make rounds with the latter. On these rounds, questions of clinical policy were thrashed out, and the care which individual patients had received was evaluated and corrected as necessary.

Constant vigilance was required to insure that surgical directives were being fully complied with. The adequacy of debridement and the splitting of plaster casts, for instance, could never be taken for granted. Even during the last month of operations on the Continent, when every medical unit in the Third U.S. Army had had several months of experience in the field, it was necessary to continue to emphasize basic surgical policies, in order to avoid occasional slip-ups during rush periods.

One of the best ways to evaluate the care which casualties were receiving in army hospitals was to check the condition of patients ready for evacuation in holding units, as well as at airstrips and at train terminals (fig. 53). From

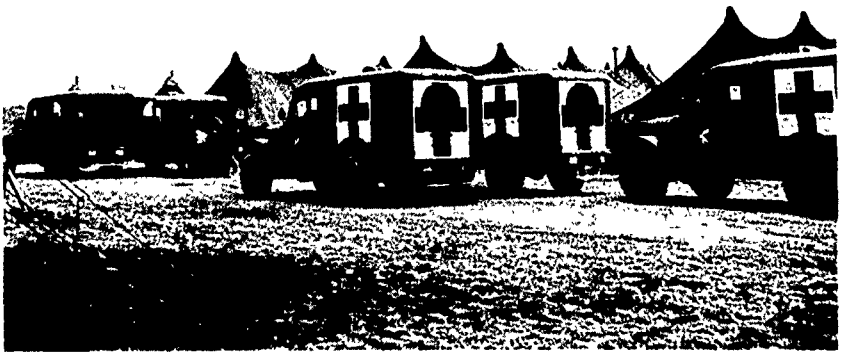


FIGURE 53.—A holding unit in the chain of air evacuation. As a rule, these units were operated by medical gas treatment battalions.

them, it was possible to get an overall idea of the type of surgery performed in the hospital units feeding casualties into these points, as well as to spot errors made by particular hospitals or by individual surgeons. When errors were discovered, the hospital responsible was promptly notified, or the individual case was traced back to the surgeon responsible, not to reprimand him but to prevent a recurrence of the error. Errors were remarkably infrequent, and care was generally on a very high level.

Observation at evacuation points also made it possible for the surgical consultant to keep the army surgeon informed of the condition of patients about to be evacuated to general hospitals in the communications zone. It was soon learned, incidentally, that it was essential to station a surgeon with sound surgical judgment and considerable experience at all holding units and evacuation points if the best interests of the patients were to be served.

A report to the surgical consultant by Maj. Dudley W. Smith, MC, based on 500 cases collected at the 94th General Hospital from the First, Third, and Ninth U.S. Armies is an excellent summary of the errors which had to be avoided in forward hospitals in the management of wounds of the extremities. The essential errors, all of which attested the paramount importance of adequate initial surgery in the combat zone, were as follows:

1. Wounds sometimes could not be closed either because they contained dead muscle and damaged fascia which had not been removed at initial debridement or because they had been blocked by heavy petrolatum-impregnated gauze wicks or improper drains.

2. Casts were sometimes not completely split, and sheet wadding was occasionally not split at all.

3. Extremities in which vascular injuries were associated with bone and joint injuries had sometimes not been correctly immobilized during transportation.

4. In a few instances, all foreign bodies in joints had not been removed.

5. Some patients subjected to amputation were grossly anemic and needed massive transfusions.

6. The existence of nerve lesions and skin losses was not always noted on the plaster cast or the field record.

The value of this sort of specific report by a competent forward surgeon (Major Smith was assigned to the 4th Auxiliary Surgical Group and was on detached service with the 94th General Hospital) is too obvious to need elaboration. It was certainly one of the best possible ways of identifying errors and having them corrected.

CONCLUSIONS

The most important lessons in the care of casualties learned in Third U.S. Army hospitals during the campaign in Europe may be summarized as follows:

1. Early, skilled care of the wounded, as near the front as possible, conclusively proved its worth. Such care can best be provided by proper triage, with diversion of nontransportable casualties to the platoon of a field hospital staffed by trained surgical teams and located in close proximity to the clearing station.

2. The staffs of evacuation hospitals should also be supplemented by surgical teams to accomplish the rapid treatment of battle casualties and the return of soldiers to duty in the Army area.

3. Surgical teams were of great value in providing medical support for armored divisions and in bridgeheads across rivers, when prompt evacuation of the wounded was often impossible.

4. By the use of these methods, it was found that definitive, lifesaving surgery could be accomplished much farther forward than had previously been realized.

5. Adequate shock therapy is founded upon the use of stored whole blood, with plasma used only as a temporary expedient until blood is available.

6. If resuscitation is not accomplished promptly and adequately, shock becomes irreversible. Profound shock was apparently the single constant factor in the fatal anuria observed in battle casualties.

7. Infection can be prevented by early, adequate debridement, supplemented by routine parenteral penicillin therapy. The local use of sulfonamides proved ineffective and often retarded wound healing.

8. Extreme conservatism should be the rule in respect to amputation, though injuries were often so mutilating that this policy was completely impractical.

9. The repair of damaged blood vessels was not feasible as a routine policy in forward hospitals in World War II. It should be practiced, however, in selected cases, with due care not to risk a life in the endeavor to save a limb. At the best, gangrene is likely to develop in about half of all vascular injuries, though the proportion is smaller in the small group of cases in which repair is considered feasible.

10. The solution of the problem of cold injury is prevention by the provision of proper clothing and footgear and by effective command discipline. Once cold injury had developed, no method of treatment was found really effective.

The morale of troops is greatly enhanced by the return of wounded men to duty in their own units. This was routine policy in the Third U.S. Army, and one which paid large dividends.

CHAPTER XVI

Fifth U.S. Army[1]

Howard E. Snyder, M.D.

Section I. Administrative and Related Considerations

APPOINTMENT OF THE SURGICAL CONSULTANT

The appointment of Maj. (later Col.) Howard E. Snyder, MC, as Consultant in Surgery to the Surgeon, II Corps, and later to the Surgeon, Fifth U.S. Army (fig. 54), initiated the consultant system in field armies in World War II.[2] His appointment came about, however, by a series of almost fortuitous circumstances.

Observations in the United Kingdom

Major Snyder was assigned to the thoracic surgery section of the 77th Evacuation Hospital, the affiliated University of Kansas Medical School unit, which, after completion of its basic training at Fort Leonard Wood, Mo., was sent to England, where it arrived early in August 1942. At the suggestion of Sir Harold Gillies, then head of the plastic surgery services of the EMS (Emergency Medical Service) in England, he requested permission to go to London, to observe the work of Mr. A. Tudor Edwards, who was head of the thoracic surgical services of the EMS. Similar permission was requested for the other members of the thoracic surgery team of the 77th Evacuation Hos-

[1] Unless otherwise indicated, data in this chapter were derived from the following sources in addition to the official diary of the consultant in surgery, Fifth U.S. Army: (1) Fifth Army Medical Service History, 1944, (2) Fifth Army Medical Service History, 1945. (3) Starr, Chester G. (ed.): From Salerno to the Alps. A History of the Fifth Army, 1943–1945. Washington: Infantry Journal Press, 1948, and (4) Medicine Under Canvas. A War Journal of the 77th Evacuation Hospital. Kansas City: The Sosland Press, Inc., 1949.

[2] Dr. Snyder, a graduate of Jefferson Medical College of Philadelphia, served a rotating internship at the Pennsylvania Hospital and received his surgical training under Dr. John H. Gibbon, Sr., at the same hospital. His training was unusually comprehensive because Dr. Gibbon believed that thoracic surgery, urologic surgery, gynecologic surgery, and traumatic surgery are all part of general surgery. Dr. Snyder's surgical training was completed under his father, an expert general surgeon, who could use a cystoscope as dexterously as a bronchoscope and who, like Dr. Gibbon, believed that general surgery covers a wide range.

The 77th Evacuation Hospital, the affiliated Reserve hospital unit of the ....cal School of the University of Kansas, was organized in the summer of 1940 but was not activated until 10 May 1942. Dr. Snyder was commissioned in the rank of major and was assigned to the thoracic surgery section. He was promoted to lieutenant colonel in July 1944 and to colonel a year later.

Colonel Snyder is another of the many medical officers whose excellent civilian training and comprehensive experience could be immediately adapted to the responsible duties they were called upon to assume in World War II. In his service, his broad general training peculiarly fitted him for the duties of consultant to the surgeon of a field army.—J. B. C., Jr.

pital. One of the members, Capt. (later Maj.) Wendell A. Grosjean, MC, was a general surgeon, and the other, Capt. (later Maj.) Harwin J. Brown, MC, was a well-qualified anesthesiologist.

It was Mr. Tudor Edwards' idea that this team should spend 10 days with him in London, 4 weeks at the Horton EMS Hospital at Epsom, and an additional 4 weeks in some other thoracic surgery center. Arrangements for the tour of duty in these hospitals, however, were slow to be consummated, and



FIGURE 54.—Maj. Howard E. Snyder, MC, Consultant in Surgery to the Surgeon, Fifth U.S. Army.

the invasion of North Africa was imminent when they were finally concluded. Instead, therefore, of the approximately 10 weeks of observation and training originally proposed, only 8 days could be devoted to this purpose.

While arrangements for this tour of duty were under way, Major Snyder's time was spent very profitably. He came to know Mr. Ronald Belsey, then head of the thoracic surgery service at the Kewstoke EMS Hospital at Weston-super-Mare, near Frenchay Park, where the 77th Evacuation Hospital was located. Mr. Belsey had completed his training in thoracic surgery under Dr. (later Col.) Edward D. Churchill, at the Massachusetts General Hospital, Boston, Mass., as well as elsewhere in the United States.

The British at this time were quite short of medical personnel. Anesthesia at the Kewstoke Hospital was in charge of a pediatrician, and Mr. Belsey had no surgical assistants. He was therefore delighted to have a surgeon to help him, and Major Snyder took advantage of every opportunity to work with him. Most of the chest surgery at this hospital was secondary surgery, on old wounds, but a certain amount of fresh work came in irregularly.

The tour of chest surgery centers and clinics began with 3 days' observation of Mr. Edwards' work. Part of the time was spent at the Brompton Hospital in London and part at the King Edward VII Sanatorium in Midhurst. It was a revelation to a thoracic surgeon who was used to the elaborate setup and teamwork of Jackson, Clerf, and Tucker to observe the performance of bronchoscopies in an operating room which had been set up correctly but in which there were no surgical assistants, no nurses, and no attendants of any kind.

Major Snyder and his associates next visited the Horton EMS Hospital, where they observed the work of Mr. N. R. Barrett and Mr. W. P. Cleland. Mr. Barrett, in addition to his work at this hospital, frequently served as consultant in thoracic surgery at various hospitals in Wales. The U.S. surgeons watched these surgeons and their associates in the operating room, made rounds with them, studied their preoperative and postoperative care, and attended their conferences. These conferences, at which cases were discussed, roentgenograms shown, and all phases of thoracic surgery covered, were particularly helpful exercises.

All of the British surgeons were uniformly courteous, hospitable, and generous in the sharing of their experiences. They included, in addition to those already mentioned, Dr. Clifford Hoyle, Mr. C. P. (later Sir Clement) Thomas, Mr. R. C. (later Sir Russell) Brock, and Mr. A. R. Hunter. The anesthesiologists at the hospitals visited, Dr. M. D. Nosworthey and Dr. S. W. Magill, were equally courteous and helpful.

The information obtained from all of the hospitals visited proved of great value when combat-incurred injuries of the chest were encountered in North Africa a few weeks later. Perhaps the most important lesson learned was the value of early and repeated aspiration of hemothoraxes without air replacements.

Experiences in North Africa

Two weeks before the 77th Evacuation Hospital sailed for North Africa on 1 November 1942, it was assigned to the II Corps, Central Task Force. Col. Richard T. Arnest, MC, was corps surgeon, and Maj. (later Col.) William H. Amspacher, MC, was his deputy (fig. 55).

The hospital debarked at Mers-el-Kebir on 11 November 1942 (D+3) and immediately took over the civilian and military hospitals at Oran, 12 miles away. As no transportation was available, Oran was necessarily reached by hiking. Chaotic conditions were found at both the civilian and the military hospitals. The patients, including the military casualties, who had been in charge of French interns, had received little medical or other care. It was a rather terrifying introduction to combat surgery.

On 24 November, the 77th Evacuation Hospital was relieved of its duties in the Oran hospitals and moved into tents (fig. 56) in a red clay vineyard about 3½ miles south of the city. Here, patients from the immediate area



FIGURE 55.—II Corps medical officers. A. Col. Richard T. Arnest, MC, Surgeon. B. Lt. Col. William H. Amspacher, MC, Deputy Surgeon.

were treated in ward tents, and boatloads of casualties, chiefly British wounded, were occasionally received from Algiers.

Since the patient load was not enough to keep the hospital staff occupied, Major Snyder (on the casual suggestion of an Air Force medical officer who had delivered patients to the hospital) requested permission to observe the work of the teams of the 2d Auxiliary Surgical Group which had been attached to the British Eastern Task Force and were then working in the British Cottage Hospital at Algiers. Permission was at once granted, with the understanding that Major Snyder's observations would be reported on his return. This was done (p. 369).

On 20 January 1943, the 77th Evacuation Hospital was moved to an area south of Tebessa, Algeria. On 14 February, it was alerted to receive casualties from the breakthrough at Kasserine Pass, and within 48 hours it had treated 150. The tactical situation then required the removal of the hospital to the rear. The move was completed in snow and freezing temperatures during the night, and by dawn 480 additional patients had been received.

Appointment as Surgical Consultant, II Corps

On 15 March 1943, Major Snyder reported on temporary duty to II Corps headquarters near Tebessa, with instructions to evaluate the use of surgical teams in clearing stations. For this purpose, he traveled with Colonel

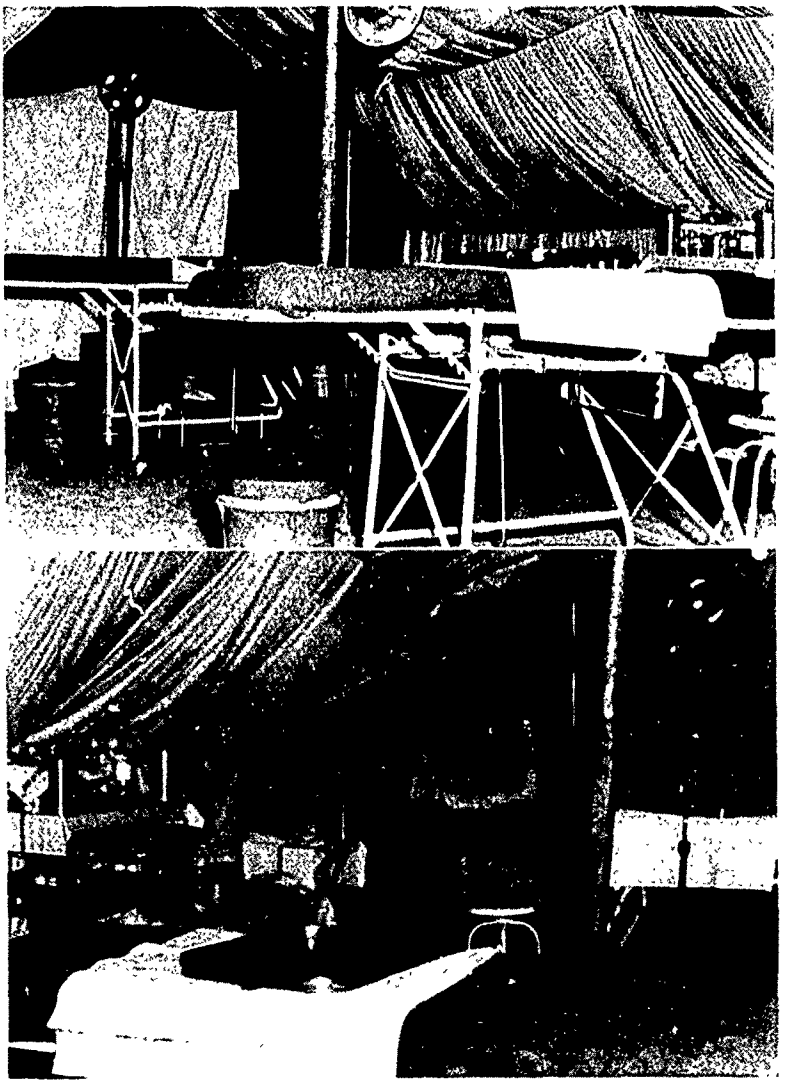


FIGURE 56.—Operating room, 77th Evacuation Hospital, North Africa.

Amspacher to various corps and other installations and also spent 6 days at a clearing station staffed by the 1st Platoon, Company D, 51st Medical Battalion, whose intrinsic personnel was augmented by two general surgical teams and one shock team from the 2d Auxiliary Surgical Group. Various recommendations were made as a result of this tour of duty (p. 369).

Shortly afterward, Col. Edward D. Churchill, MC, Consultant in Surgery in the Office of the Surgeon, NATOUSA (North African Theater of Operations, U.S. Army), suggested to Colonel Arnest, the Corps surgeon, that Major Snyder be retained at Corps headquarters in the capacity of surgical consultant.

Colonel Arnest at first hesitated to act on the suggestion because the headquarters table of organization had no provision for such a position. Eventually, however, Colonel Arnest appointed Major Snyder as his professional service officer, though his duties were confined to surgery.

Major Snyder remained with II Corps headquarters, though he was not formally assigned to it until just before the invasion of Sicily on 10 July 1943. He went ashore with the invading troops on D-day, at H+3.

Appointment as Surgical Consultant, Fifth U.S. Army

The Sicilian campaign ended on 17 August 1943. On 20 September, Major Snyder received orders for temporary duty in the Office of the Surgeon, NATOUSA, in Algiers. On his arrival, he was informed that Brig. Gen. Frederick A. Blessé, Surgeon, NATOUSA, was then in Italy with Col. (later Maj. Gen.) Joseph I. Martin, MC, Surgeon, Fifth U.S. Army, and that it was General Blessé's intention, on Colonel Churchill's suggestion, to ask Colonel Martin whether he would like to have Major Snyder as surgical consultant for the Fifth U.S. Army.

On his return to Algiers on 5 October 1943, General Blessé reported that Colonel Martin had willingly acceded to Colonel Churchill's suggestion. Major Snyder was ordered to return to Sicily and join II Corps headquarters, which was then preparing to move to Italy. After overcoming a variety of transportation and other difficulties, he finally reached Fifth U.S. Army headquarters in Naples on 11 October 1943. Until 19 November, while still assigned to II Corps headquarters, he acted as consultant in surgery to the Fifth U.S. Army. On this date, his permanent orders were received. He continued to serve in this position until 1 October 1945, when Fifth U.S. Army headquarters disembarked at Boston (fig. 57).

As this account indicates, Major Snyder's appointment as consultant in surgery, Fifth U.S. Army, developed by a series of chance circumstances. His appointment was the prototype of the consultant system in all U.S. armies in World War II.

TACTICAL CONSIDERATIONS

Sicily

Major Snyder, who had been assigned to the II Corps as surgical consultant (p. 337) shortly before the invasion of Sicily, landed in Sicily on D-day (10 July 1943) at H+3, with the 261st Amphibious Medical Battalion. He was in the first group to go ashore from the U.S.S. *Samuel Chase*, on which this unit, with its headquarters, had been transported. For some reason, never clear, the headquarters of the unit was landed 4 hours ahead of any of its three companies.

The first casualties on D-day were handled by the Navy, in beach stations set up in each of the six landing areas. The stations were set up promptly, and



FIGURE 57.- Lt. Gen. Lucian K. Truscott, Jr., Commanding General, Fifth U.S. Army, congratulating Lt. Col Howard E. Snyder, MC, Consultant in Surgery, Fifth U.S. Army, after awarding him the Legion of Merit for exceptionally meritorious service in the performance of his duties.

their personnel did excellent work in instituting first aid measures and then evacuating the casualties to ships offshore.

Company C of the 261st Amphibious Medical Battalion landed, as planned, on D-day at H+7, but without its equipment. It set up a station with the equipment of Company B, whose personnel were not landed until the afternoon of the next day. A number of other units experienced similar difficulties in the landing of equipment without personnel or vice versa, but evacuation of casualties (fig. 58) to the beaches and thence to the boats proceeded with remarkably little confusion.

On D+2, the APA's (transports, attack) and XAPA's (experimental APA's) finished unloading and left the beach. Thereafter, all casualties in this area received initial care either in the clearing station of the 51st Medical Battalion with surgical teams attached or in Company A of the 261st Amphibious Medical Battalion, both of which were corps units.

On D+3, two platoons of the 11th Field Hospital began to receive and hold casualties, and the 93d Evacuation Hospital began to function on D+6. The 15th Evacuation Hospital had been landed on D+4, but its equipment did not begin to arrive until 2 days later, and it was D+10 before all of it was received.



FIGURE 58 Evacuation of wounded from Sicily A. Loading of wounded on landing craft B. Wounded aboard landing craft

After D + 3, the medical service problem was to provide support for troops which were pursuing a retreating enemy. The solution of the problem was the use of platoons of field hospitals set up in close support of division clearing stations and augmented by varying numbers of teams from the 2d Auxiliary Surgical Group.

Triage at the division clearing stations was excellent, as the small proportion of the total casualties admitted to field hospitals reflected; all were severely

wounded. Surgical care in the platoons of the field hospitals was prompt and excellent. When the division clearing station moved forward, the field hospital platoon beside it was closed to admissions and served as a holding hospital for postoperative cases, while another platoon came forward and set up alongside of the division clearing station. As a result of these arrangements, the medical care supplied was, up to that time, the best in the theater. The nontransportable casualties of the II Corps received initial wound surgery within 8 to 12 miles of the frontlines.

Excellent surgical care was also provided for transportable casualties at evacuation hospitals. The 400-bed semimobile evacuation hospital proved to be a satisfactory and practical unit. One reason was that hospitals of this size could be moved rapidly into new locations, a policy which proved necessary at frequent intervals during the fighting in Sicily.

Italy

The Sicilian campaign ended with the fall of Messina, Sicily, on 17 August 1943. On 3 September, the British Eighth Army landed on the toe of the Italian Peninsula, and 6 days later, on 9 September, the Fifth U.S. Army landed at Salerno, south of Naples (fig. 59). Italy surrendered the same day. Naples fell to the Allied armies on 1 October, and 12 days later, on 13 October, Italy declared war on Germany. The Germans were slowly pushed up the Peninsula until 3 February 1944, when they forced the Allies to a standstill at Cassino, on the Gustav Line.

Meantime, on 22 January 1943, elements of the Fifth U.S. Army and other Allied troops had made a landing at Anzio, south of Rome, with the expectation that union with the other Allied forces in the south would occur in about a week. It did not occur until 25 May, more than 4 months after the invasion (p. 410). Rome fell on 4 June 1944, 2 days before the invasion of Normandy.

All through the early summer of 1944, the Fifth U.S. Army pursued the fleeing German troops. The medical problems of the first months in Italy, which had been the care of casualties while new hospitals were being acquired and inexperienced medical officers were being trained, were now exchanged for the problem of keeping hospitals near enough to the front to receive and care for the wounded.

Concentration on the events in the European theater often clouded the realization that fighting was also extremely heavy in Italy. German resistance became increasingly strong as the summer of 1944 advanced. As an illustration, Rosignano, a small town on the road to Leghorn, was reached on 4 July. The southern third of the town was occupied on that date, but the northern edge was not reached until the evening of 7 July. Even then, the enemy held houses on the outskirts of the town and in the country immediately behind it. Leghorn fell to the Allies 18 July. The last 20 miles of the advance to the Arno were extremely difficult, and there were numerous hard-fought engage-

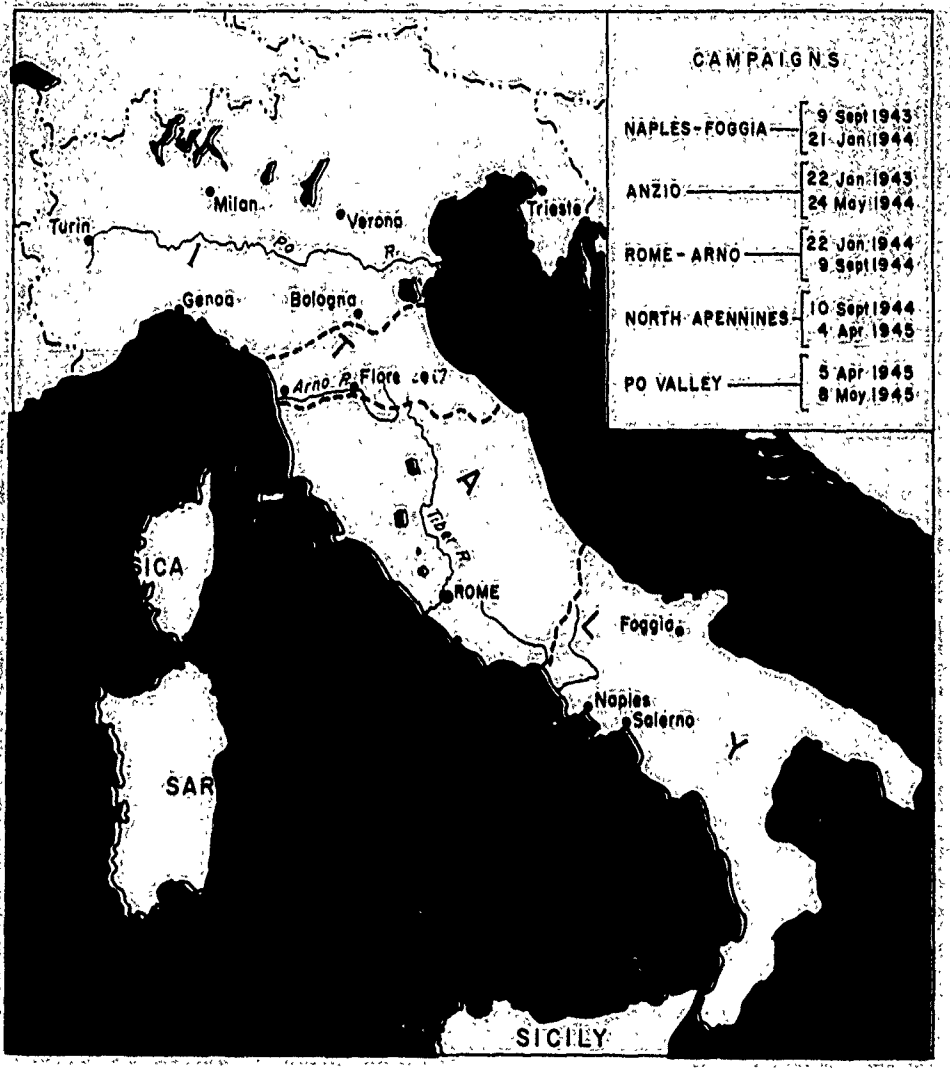


FIGURE 59.—Campaigns in Italy, 9 September 1943–8 May 1945.

ments because the Germans were trying to delay the Allied advance until their fixed defenses on the Gothic Line were completed. This line was to prove even harder to breach than the Gustav Line, which had held the Fifth U.S. Army below Cassino so many weeks during the first winter of the fighting in Italy.

After Fifth U.S. Army troops and their supporting medical installations had been withdrawn for the invasion of southern France (p. 396), the army in Italy underwent considerable regrouping before the North Apennines Campaign was launched on 10 September 1944. The drive to the north came to a halt with the heavy rains in late October (fig. 60). Enemy resistance increased,



FIGURE 60.– Evacuation hospital in Italy during the wet season in the fall of 1944.

and supply routes were so clogged with mud that they were almost impassable. The advance was not resumed until the middle of April the following year. When it was stopped, the forward troops could see their objectives; Bologna was barely 9 air miles away in the center, and the Po Valley was only 4 miles away on the right flank.

Winterizing of hospital installations was delayed because, on a number of occasions after the drive to the north came to a halt, it was thought that another attack was to be launched. On at least one occasion, Christmas Eve, hospital units were informed that the drive would start that night, but a few hours later word was received by courier that it had again been postponed. Shortly afterward, the Surgeon, Fifth U.S. Army, received permission to provide wooden floors for the hospitals, install enough potbellied stoves to keep the wards reasonably warm, and undertake such other winterizing as was possible.

Even though there was no active offensive during the winter of 1944–45, the situation was never entirely static. Early in February 1945, for instance, the 92d Division successfully completed a brief assault to consolidate its position and secure several dominating hills. At about the same time, the 10th Mountain Division captured the bitterly contested Monte Belvedere (fig. 61), and in the first week of March, in another limited offensive, the same division gained 8 miles.

These and other actions, even in the absence of a large-scale offensive, produced temporarily heavy casualty loads for Fifth U.S. Army hospitals, in

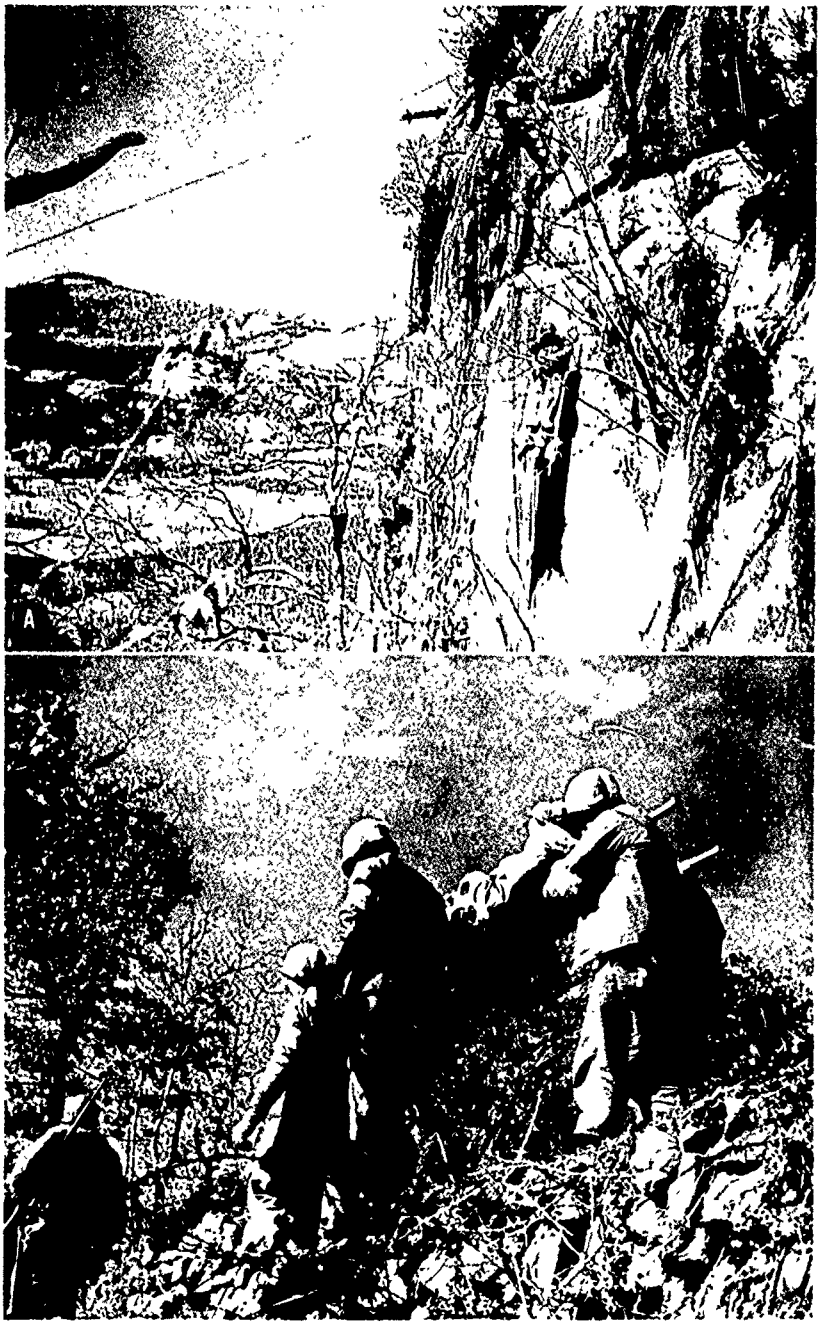


FIGURE 61 Evacuation of wounded by aidmen of 10th Mountain Division during Monte Belvedere offensive. *A*, Vertical evacuation down side of cliff and by so-called Tyrolean traverse. *B* Litter bearers working along crest of mountain

addition to the usual flow of casualties, which was small but continuous. The 8th Evacuation Hospital, which had been set up at Pitramala and had been thoroughly winterized, received the largest numbers during the first 3 months of 1945.

During the winter months of 1944–45, it was the policy to move casualties with severe injuries directly from the installations at which they had received initial wound surgery, whether field or evacuation hospitals, to either the 24th General Hospital in Florence or the 70th General Hospital in Pistoia. Casualties with less serious injuries were evacuated to base hospitals in Leghorn and Rome.

The campaign for the Po Valley, the last campaign of the war in Italy, began on 14 April 1945. Bologna was captured on 21 April, and on 2 May German troops in Italy, with those in southern Austria, surrendered unconditionally to Allied forces.

Medical planning.—Medical planning was progressively better in each campaign in Italy, and the planning for the terminal campaign resulted in better medical support for the troops than they had ever before received. This excellent record was achieved in spite of two difficulties, as follows:

1. The casualty load was greatly increased. The medical service, though it had never received adequate increments to replace the trained personnel which it had been obliged to surrender for the invasion of southern France (p. 396), had to care for Brazilian and Italian troops as well as troops of the Fifth U.S. Army.

2. Frequent moves were necessary during the last weeks of the fighting, to keep up with the advancing Allied forces. All units, including medical units, were ordered to reduce their equipment to the barest essentials and to employ any improvisation which might increase their mobility.

Colonel Snyder's participation in the planning for the final campaign was more intimate than in any previous campaign. He had access to all tactical plans, he was consulted on all points which involved medical planning, and his advice was accepted concerning the placing of field hospital platoons and other administrative matters, as well as concerning the staffing of the medical units to be committed.

The Anzio Beachhead

For a variety of reasons, the most serious medical problems encountered in Italy were met on the Anzio beachhead (Operation SHINGLE).[3] The operation was planned to weaken the German Gustav Line, which was holding the Fifth U.S. Army forces in check at Cassino. It developed into a holding operation against a numerically superior enemy, the outcome of which, on at least half a dozen occasions, was decidedly in doubt.

Special medical planning was necessary for the Anzio invasion because shore-to-ship evacuation of casualties would require closer and longer coopera-

[3] Bauchspies, R. L.: The Courageous Medics of Anzio. Mil. Med. 122: 53–65, 119–128, 197–207, 267–272, 338–359, and 429–448, January–June 1958.

tion between the Army and the Navy than had previously been necessary. The basis of the planning, which was well rehearsed in advance, was the orderly return of casualties to the beaches and their transfer thence to ships. It was due to General Martin's foresight and careful planning that the medical operation, in spite of all the difficulties which attended it, continued to be efficient throughout.

Landings.—The initial stages of the landings went off remarkably well. The landing, which was apparently a complete surprise to the enemy, was effected without resistance, and by noon of D-day the VI Corps had reached its preliminary objectives ashore. Medical units were put ashore many hours ahead of the estimated times, with ample supplies (p. 394). The 2d platoon of the 33d Field Hospital was landed at H+6, with attached surgical and shock teams from the 2d Auxiliary Surgical Group. The 1st and 3d Platoons of this hospital were in the bay but were not landed until D+1 because they were not needed earlier. Casualties were less than 1 percent of the troops committed in the landings, instead of the estimated 12 percent.

The campaign.—These satisfactory conditions continued for only about 48 hours. Then the tactical situation worsened, and the medical situation along with it. The light bombing raids on D-day increased in intensity and thereafter were a permanent part of the picture. Hospital ships were bombed in the bay, and one of them, with 75 patients on board, was sunk. By 1 February, no area was safe from enemy planes. Practically continuous bombing and strafing of the beachhead area were punctuated by heavy attacks at intervals.

The original locations of the hospitals which had landed on the beachhead promptly became untenable. They were relocated in open terrain, as far as possible from military objectives, but the best this could be was not very far, for the beachhead was only about 7 miles in depth. There were no functional distinctions between field and evacuation hospitals. Both were practically on the frontline. There was no protection in depth from enemy fire. Antiaircraft batteries, ammunition dumps, an airfield, and other military installations were of necessity located on the edge of the medical areas.

Since enemy fire could reach every part of the beachhead, casualties were heavy. The 95th Evacuation Hospital was practically destroyed by bombing early in February, and the 33d Field Hospital was also heavily shelled. There were heavy casualties after both incidents. In addition to the wounded, 4 nurses, including the chief nurse and her assistant, 2 medical officers, and 16 enlisted men of the hospital complement were killed at the evacuation hospital, and 2 nurses and an enlisted technician were killed at the field hospital. It is doubtful that the medical installations on the beachhead were deliberately bombed. They were clearly marked, as prescribed by the Geneva Convention, but it was practically impossible to separate them from legitimate military targets. The bombing of the 95th Evacuation Hospital was definitely accidental. The pilot of the German plane jettisoned his bombs when he was try-

ing to escape British Spitfires. The plane was shot down, but the pilot escaped by parachute and was captured on the beachhead.

Personnel on the beachhead lived in a world of unpredictable violence, in which medical personnel shared. Most of the damage and casualties were caused by air raids and artillery fire, but on one occasion, in February, German tanks almost broke through to the hospital area. It was not unusual for patients to have to be evacuated from one hospital to another, sometimes with attendants continuing transfusions en route, one holding the bottle while another steadied the needle.

Had it not been for the 700-year-old wine caves on the beachhead, which served for billets, headquarters, and other purposes, casualties would undoubtedly have been much heavier. In March, after the soil had begun to dry out from the incessant rains of the winter, the medical services went underground (fig. 62). Excavations were pr , ed to a depth of 3½ feet, with revetments around them, and sandbag baffles were placed around double ward tents. Sheet metal was placed over pyramidal tents and covered with sandbags. Patients, nurses, and medical personnel on the wards were thus fairly well protected.

Operating rooms were similarly constructed and protected. This was most important. Previously, when an air raid warning had sounded while an operation was in progress, the personnel engaged in it had had no choice but to continue with what they were doing. With the protective measures now taken, only direct hits need be feared.

Evacuation.—From the beginning of the Anzio operation, an attempt was made to care for all casualties before they were evacuated by LCT's (landing craft, tanks) and boat ambulances to hospital ships. If recovery was expected within 14 days or less, the wounded were kept in evacuation hospitals on the beachhead. If it was believed that it would take longer, both soldiers and any of the remaining civilians who had been wounded or who were ill were evacuated to the Naples area as soon as they could be moved. As many effectives as possible had to be retained, and experienced combat soldiers were never evacuated unless there was no other course. Slightly wounded and sick were evacuated because the bed space had to be saved for the wounded who needed it more. Eventually, a 200-bed hospital was set up on the beachhead for the diagnosis and treatment of venereal disease, and a 400-bed holding hospital was also set up to take the pressure off the field and evacuation hospitals. These two plans made it possible to retain on the beachhead many thousands who otherwise would have had to be evacuated.

In the opinion of surgeons on the beachhead, casualties were often evacuated to the base earlier than was desirable. On the other hand, when Colonel Churchill visited the hospitals of the beachhead on 2 June 1944, in the course of the breakout, he expressed the opinion that casualties were being held too long. Air transportation had begun only a week before, on 26 May.

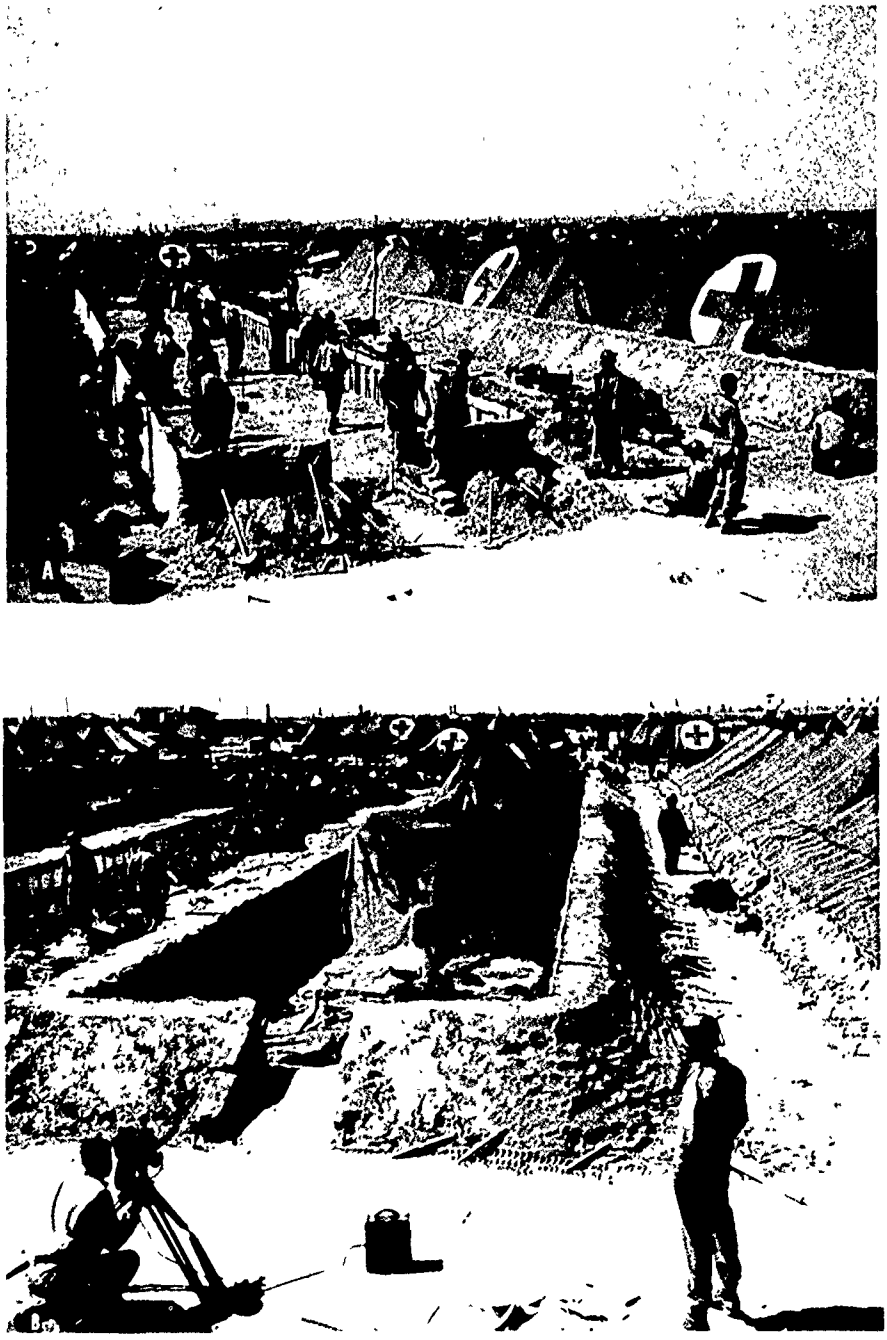


FIGURE 62.—Tents of 56th Evacuation Hospital being dug in on Anzio beachhead, April 1944. A, Construction of side walls for tent. B, Erection of tent.

Occasionally, when the casualty load was unusually heavy on the beachhead, men who were transportable were evacuated to base hospitals in the Naples area for initial wound surgery, which they thus received earlier than they would have if they had been kept at Anzio.

Workload.—The routine at the 33d Field Hospital was typical of the demands on a frontline installation at the Anzio beachhead. Four operating tables functioned almost continuously. The six surgical teams attached to the hospital from the 2d Auxiliary Surgical Group were divided into three groups of two teams each. Each group was on first call for 12 hours, on second call for another 12 hours, and off duty for a third 12-hour period.

When casualties once reached a hospital, the timelag was seldom more than that necessary for resuscitation, thanks to careful planning and supervision. At one time, for instance, the 56th Evacuation Hospital had a backlog of 150 cases, which was heavier than the workload of any other hospital, though all were busy. As soon as the other hospitals had cleared up their smaller backlogs, 75 patients were transferred from the 56th Evacuation Hospital and distributed among them, thus equalizing the timelag. Later, it was found necessary to enlarge this hospital, so that it had eight operating tables and three tents for preoperative preparation.

Wounds were not the only medical problem on the beachhead. There was a high incidence of trenchfoot (p. 431). Casualties from malaria were also high. Malaria was endemic in the Anzio-Nettuno area, which was part of the Pontine Marshes, and it was estimated that at least one in every 20 of the civilians (most of whom had been evacuated to Naples by Allied Military Government) had chronic malaria. Malaria was also present in U.S. Army troops who had been in North Africa and Sicily and in Italy below Rome. An aggressive antimalarial program, including the administration of quinacrine hydrochloride (Atabrine) and an all-out sanitation attack, helped to bring this disease under control.

Random statistics from the Anzio beachhead indicate the amount of surgery required there. Between 30 January and 22 February 1944, the 56th Evacuation Hospital admitted 5,345 patients and operated on 3,663. The 93d Evacuation Hospital, which was heavily bombed during the same period, averaged just over 44 operations per day, the number ranging from 4 on one day to 111 on another. During the final offensive, hospitals on the beachhead received 1,400 casualties during the first 24 hours and 800 during the second. Figures for the period 12–16 May (table 5) are typical of the number of operations performed in hospitals during this final phase.

Between 22 January and 22 May 1944, U.S. Army hospitals on the Anzio beachhead handled 33,128 casualties from all causes, and between 23 May and 5 June they handled 15,200. The figures for British hospitals for the same period are, respectively, 14,700 and 2,196. In all, 47,193 persons were evacuated from Anzio during the course of the operation. Capt. Eugene F. Haverty, MC, evacuation officer from the Office of the Surgeon, Fifth

TABLE 5.—*Operations performed in hospitals on Anzio beachhead during the final phase, 12–16 May 1944*

Hospital	Operations				
	May 12	May 13	May 14	May 15	May 16
8th Evacuation	127	57	113	9	8
56th Evacuation	161	128	48	27	21
16th Evacuation	83	104	93	83	48
93d Evacuation	170	125	45	13	12
95th Evacuation	118	71	90	83	53
10th Field	40	21	28	7	4
11th Field	37	35	21	18	12

U.S. Army, was killed by a shell while supervising the loading of casualties on an LST (landing ship, tank). Otherwise, there was no loss of life among casualties or medical personnel in the course of the evacuation.

Weather

The weather in Italy added materially to the difficulties of medical care in a combat area. During the summer months, it was extremely hot. During the fall and winter of 1943–44, there was almost unbroken cold, rainy weather, which complicated the evacuation of casualties in mountain warfare and also resulted in a serious outbreak of trenchfoot. During the succeeding winter, the weather was much the same, but fighting was generally less intensive. The 8th and 94th Evacuation Hospitals, however, as well as several field hospital units, operated in the mountains in snow for several months. The temperature went below freezing in November, and thawing did not begin until after the middle of February.

Some hospitals also suffered catastrophic damage as the result of weather. Early in November 1944, the Arno River broke over its retaining wall and inundated the area of the 38th Evacuation Hospital, then set up near Pisa. Almost 500 patients and the attendant medical personnel had to be moved to a building 300 yards away, which housed the advance platoon of the 12th Medical Depot. The water, which ultimately reached a height of 6 feet in some areas, was almost 4 feet high before the last patient had been moved. A great deal of equipment was lost, including part of the surgical consultant's personal instruments for chest surgery.

In December 1944, after most of the hospitals had completed their winterizing, which had been delayed in the belief that an offensive would be launched, heavy rains and high winds from the central Apennines nullified much of the work already done. At the 8th Evacuation Hospital, then set up near Pitramala, 8 ward tents were blown down, and 40 patients recently operated on had to be transferred to the 15th Evacuation Hospital. Later

in the day, when additional tentage was uprooted, all the other patients in the hospital were evacuated as a precautionary measure.

In Italy, tents were frequently set up in the form of a cross or side by side, to simplify lighting and heating and reduce exposure of personnel. This plan also lessened the chances of the tents' being uprooted and blown over.

FUNCTIONS OF AN ARMY CONSULTANT

The duties and responsibilties of the consultant in surgery, Fifth U.S. Army, were, in general, those of all army consultants. His basic function was to assist the army surgeon in providing care of the highest quality for wounded men and for all others who for any reason required surgical care in the combat zone. His functions were peculiar to this army only in the sense that they were evolutionary.

Although Major Snyder's duties varied according to the special phase of combat, they were, in general, as follows:

1. He evaluated for the army surgeon and his executive officer the professional capabilities of all surgical personnel (p. 353). This frequently required the recommendation of transfers of personnel from unit to unit, to channel off excesses of surgical talent in some organizations and to improve the level of performance in other, weaker organizations.

2. In cooperation with the theater consultant in surgery, he directed the educational programs by which medical officers, fresh from civilian life, became acquainted with the requirements of military surgery. He also occupied himself with modifications of planning and techniques by which errors could be corrected and the level of surgical performance elevated.

3. He served, in effect, as a channel of surgical information between the various installations in the army area. This made possible the rapid transmission of suggestions, techniques, improvisations, and other useful ideas which otherwise would have been disseminated slowly or perhaps might have been lost entirely.

4. He worked in close liaison with the corps surgeons who directed the movement and operations of field hospital units set up adjacent to division clearing stations. In particular, he recommended the assignment of teams from auxiliary surgical groups to these units.

5. He endeavored to improve the performance of individual evacuation hospitals in special aspects of surgery by attaching to them, according to their needs, highly trained surgical teams to assist and train organic personnel.

6. He assisted in the planning of the surgical component in the support of combat operations, working in close cooperation with the chief of the operations section in the army surgeon's office. This cooperation was fullest, and therefore most fruitful, in the later phases of the fighting in Italy.

7. He advised the army surgeon on such matters as triage, evacuation, the nature and limitations of the surgery to be performed in the various echelons

of medical care, and the holding period after operation in field and evacuation hospitals.

8. He made regular tours of inspection of medical installations in the army area, advising and assisting the staff as necessary. On his return from these tours, he reported his observations to the army surgeon and to the consultant in surgery to the theater surgeon, evaluating the qualifications of each hospital staff and the total hospital performance.

9. On these tours, he saw seriously ill patients in consultation or examined other patients in the hospital on request. Also, in compliance with a number of suggestions made to him to this effect, he demonstrated the techniques of forward surgery in newly arrived hospitals. In other hospitals, when the patient load was heavy during rush periods, as frequently happened on the Anzio beachhead, for instance, he took his turn at the operating table with the hospital staff.

10. He advised the army surgeon and his medical supply officer on all matters of surgical equipment (p. 391) and also advised the installations he visited on the most efficient use of their equipment.

11. He analyzed clinical records and post mortem reports on all battle casualties who died in army hospitals (p. 399), in order to weigh the relative merits of various surgical procedures and to evaluate the correctness of the therapy employed in the individual fatalities. These observations led to recommendations for changes in policies and techniques as well as to other recommendations.

Major Snyder also performed a number of other duties not particularly related to his position as consultant in surgery, Fifth U.S. Army, but arising in the course of the war. One of these duties was to serve on a general court-martial. Another, the most painful task he had to perform during his entire military service, was to serve as medical officer at the hanging of four rapists in Sicily and to pronounce these men dead.

It was most important, in the performance of his numerous duties, that Major Snyder immediately establish frank, correct relations with the staffs of the Fifth U.S. Army hospitals. Early in his experience, he encountered a considerable amount of suspicion of both his functions and his motives; some of it was covert, but some of it was quite openly expressed. This attitude was almost inevitable; as already pointed out, this was an entirely new assignment, and there was no past experience to serve as a point of reference. Once the proper relations were established, however, and the potential usefulness of the consultant system was realized, Major Snyder was always received with great cordiality, and his visits were utilized to the fullest.

From the beginning of his assignment, Major Snyder spent most of his time in the field, sleeping at Headquarters, Fifth U.S. Army, no oftener than once or twice a week. Periods spent in individual hospitals varied from a few hours to several days, depending upon their location, their special needs, and the tactical situation. Both the number and the duration of his visits were chiefly determined by the workload. His repeated visits to Anzio, for instance, were

required by the continuing seriousness of the tactical situation, which kept all the hospitals in the area taxed far beyond their normal capacity.

In March 1944, when Major Snyder was provided with his own transportation and a driver, he was able to increase the number of hospitals visited because he was no longer dependent on others for his movements.

EVALUATION AND ASSIGNMENT OF PERSONNEL

The questionnaires, which all medical officers completed, provided a reasonably adequate record of the officers' medical training and civilian experience. These records were kept up to date in the army surgeon's office. The information which they contained was available to the commanding officers of hospitals, and assignments could be made in the light of recorded professional qualifications.

It was a fairly common experience that paper qualifications, however fairly they might be recorded, were not always matched by performance in the field and under stress. It was not possible to judge the potential of any medical officer until he had met such tests. Evaluation of the capacity of individual surgeons, as distinguished from their training and experience, required observation of their work. Their correct assignment was based upon these observations, and this function therefore came to be one of the most important duties which the surgical consultant for the Army had to perform.

Major Snyder spent considerable time at this task, but, because of the large number of hospitals in the Fifth U.S. Army area, he could not always undertake it himself and had to rely upon the estimates of the chiefs of surgery in the hospitals. To accept their evaluations, however, it was necessary that they first be evaluated themselves. Their judgment of others depended upon their own training, experience, ability, and potentialities.

It was extremely important that the chief of surgery in any forward hospital be an officer of special competence in surgery; that he be levelheaded under stress; and that he possess the administrative ability to organize and direct the work of the surgical section. Previous experience with forward surgery in North Africa and Sicily was a most valuable qualification for officers who served in these positions in the Fifth U.S. Army. Most of them were extremely capable men, who rendered outstanding service both professionally and administratively. A small number were not competent and had to be replaced.

The evaluation of the surgeons in the surgical and shock teams of the auxiliary surgical groups was another function of great importance. These teams served in field hospitals (p. 385), which took care of urgent, first priority surgery, and it was essential that highly competent surgeons be assigned to them. Here, also, paper qualifications did not always prove an infallible index of ability, though these teams had an unusually high proportion of surgeons with special ability and training.



FIGURE 63. Col Edward D. Churchill, MC, Consultant in Surgery to the Surgeon, NATOUSA, Col. Frank B. Berry, MC, Consultant in Surgery to the Surgeon, Seventh U.S Army, Col. James H. Forsee, MC, Commanding Officer, 2d Auxiliary Surgical Group, and Lt. Col Howard E. Snyder, MC, Consultant in Surgery to the Surgeon, Fifth U.S Army.

Whenever possible, all newly arrived surgeons worked first in evacuation hospitals, where their work could be supervised and evaluated before they were assigned to the hospitals still farther forward, in which special qualifications and initiative were required.

Once the surgical personnel of any unit had been evaluated, conferences on recommendations for transfers were held with Colonel Churchill (fig. 63), and the army surgeon and his personnel officer were then advised of the results of the hospital inspection, with particular reference to deficiencies which required correction.

There were two ways of correcting these deficiencies. Whenever possible, weak personnel were replaced by properly qualified personnel, while the less qualified officers were transferred to units in which they could work under supervision. It was surprising how often such supervised training converted initially weak personnel into entirely reliable surgeons. If immediate changes in assignment were not possible, weakness in a hospital unit was overcome by augmenting the organic staff with surgical teams from an auxiliary surgical group or with surgeons on temporary duty from other hospitals. If the hospital deficiency was in one or another of the specialties, it could often be corrected by the temporary assignment to the hospital of thoracic, orthopedic, and maxillofacial surgeons and neurosurgeons from auxiliary surgical groups.

In December 1944, arrangements were made in the Office of the Surgeon, Peninsular Base Section, to send teams from evacuation hospitals to base hospitals for 6 weeks' temporary duty, while similar teams from base hospitals served for the same length of time in forward units. This policy, which proved very profitable, was continued until the heavy fighting during the breakout into the Po Valley in April 1945 made it impractical.

Nurses and enlisted personnel.—In August 1944, before the invasion of southern France, there were 14 medical units in the Fifth U.S. Army area to which nurses were assigned. Of the 14 units, 4 were field hospitals, with 18 nurses each; 5 were 400-bed evacuation hospitals, with 40 nurses each; 4 were 750-bed evacuation hospitals, with 53 nurses each; and 1 was the 2d Auxiliary Surgical Group, with 65 nurses.

Nurses were always in short supply, and the nursing care of first priority casualties after surgery was a continuing problem. When the patient census in a field hospital platoon exceeded 20, as it frequently did, the 6 nurses provided for by the table of organization could not handle the load. The deficiency was usually met by sending forward nurses from evacuation or base section hospitals to augment field hospital personnel during the rush periods.

The nurses of the Fifth U.S. Army rendered superb service and contributed incalculably to the morale of the troops. This was particularly true at the Anzio beachhead (fig. 64), where six nurses were killed and a number of others were wounded.

Enlisted men who helped to care for the wounded in all capacities, from the battlefield to the rear of the Fifth U.S. Army area, are deserving of the same high praise. There were many casualties among them and many instances of almost incredible bravery and devotion to duty. Pfc. Lloyd C. Hawks, Medical Detachment, 30th Infantry Regiment, was awarded the Congressional Medal of Honor for devotion beyond the call of duty at Anzio.

Rank.—The numerous contacts necessary between medical officers of the Fifth U.S. Army and the British medical officers serving in the same command were often complicated by embarrassing discrepancies in rank. Throughout the war, at medical conferences as well as at conferences between officers in all other branches, the British were usually represented by officers who outranked U.S. Army officers by at least one rank and often more. The counterpart of Col. (later Maj. Gen.) Joseph I. Martin, MC, Surgeon, Fifth U.S. Army, for instance, was the Surgeon of the British Eighth Army, who was a major general.

These discrepancies often made for embarrassment if not actual difficulties. The explanation of the higher British rank was frequently inherent in their system. In the British Army, an officer, on being assigned to a task which called for a certain rank, was given that rank temporarily if he did not already



FIGURE 64.—Nurses on Anzio beachhead. A. Nurses digging foxholes. B. Nurses loading sandbags around their tent.

possess it. When the task was finished, he reverted to his original and permanent rank.

EDUCATIONAL ACTIVITIES

Many of the surgical techniques of previous wars have become obsolete at the outbreak of another war. More important, the lessons of past wars are readily forgotten, if indeed they are ever fully learned. Finally, while there is always a progressive evolutionary improvement in surgical techniques between wars, some of these techniques are not applicable to combat surgery, and others are applicable only after they have been modified.

Mistakes, therefore, are almost inevitable in the management of the wounded in the first days of any war. New methods of merit develop rapidly, it is true, but they are learned and applied only if deliberate efforts are made to educate newly inducted medical officers into the principles of wartime surgery; to teach them the modifications of peacetime methods which wartime requires; and also to teach them that the techniques of peacetime, however admirable they may be, usually cannot be applied wholesale to military surgery.

There were two reasons for the confusion in the management of combat-incurred injuries which occurred in the early days of the North African fighting. The first was that the lessons of World War I, explicitly set forth in the official history of the Medical Department, had to be relearned. Only a few medical officers in the North African theater even knew of the existence of these very useful volumes, and even fewer knew what they contained.

The second reason was that there were almost no medical officers in the North African theater who were familiar with the lessons the British had learned during the 3 years in which they had been in the war and in which they had had an extensive experience in Africa. It might be sound policy between wars to send consultants and other medical observers to foreign countries, to study their medicomilitary techniques. Certainly, it should be the practice, whenever friendly countries permit it, to send observers to conflicts in which the United States is not participating. Finally, once the United States enters a war, every effort should be made to capitalize on the previous experience of her allies.

These principles were not put into practice in World War II. It has already been pointed out that when Major Snyder's hospital was in England in 1942, before it was ordered to North Africa, his endeavors to capitalize on the British wartime experiences in chest surgery were successful only after a long delay, and in the end the time thus spent was only a fraction of what originally had been planned (p. 334).

The experience in other theaters was the same as in the North African theater, and for these reasons the educational activities of a consultant in surgery to a field army were always extremely important.

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Methods

The educational program for surgery in the Fifth U.S. Army was, in both its formal and informal aspects, primarily the responsibility of the army surgical consultant. It was the consultant's duty so to plan and implement this program as to insure the accomplishment of three objectives, as follows:

1. Rapid dissemination of knowledge of medicomilitary methods among medical personnel already within the Fifth U.S. Army area.

2. Rapid education of newly arrived units in the principles and techniques of combat surgery.

3. Transmission of reports of accumulating medicomilitary experience through channels (the Surgeon, Fifth U.S. Army, to the theater surgeon), so that surgeons in general hospitals in the base section might know the problems encountered in the army area.

These objectives were accomplished in the following ways:

1. Both informal and formal meetings were held (p. 362). The presentation of special problems and new techniques at these meetings and, even more, the free and uninhibited discussions which followed these presentations proved an invaluable as well as extremely interesting means of instruction.

2. The surgical consultant visited all installations in the army area as often as possible. Personal contacts with individual surgeons in field and evacuation hospitals as well as in battalion aid stations, clearing stations, and collecting stations materially reduced what might be termed the educational timelag. Conferences with small groups and sometimes with the entire surgical staff permitted the exchange of ideas, the suggestion of changes, and the tactful correction of errors.

If all the surgeons on the staff could not be seen personally, conferences with the chief of surgery and ward rounds with him and his associates provided opportunities for the evaluation of the work being done and the care the patients were receiving. These rounds also furnished opportunities for informal consultation on difficult and obscure cases. Observation of work in operating tents could be followed by appropriate suggestions to the chiefs of service or to individual surgeons, as the opportunity presented.

All of these plans permitted effective teaching which was, perhaps, the more valuable because it was both practical and unobtrusive.

3. Conferences with individual surgeons in divisional medical services served to keep the consultant informed of the problems which arose in the division area and promoted better management in all echelons because of the ensuing discussions and the decisions reached at them. These decisions were rapidly conveyed to all the medical installations in the Fifth U.S. Army area. Medical officers of line divisions were encouraged to visit hospitals and other medical installations in the rear, on the ground that an understanding of the needs and problems of all echelons by all echelons made for better care of the wounded in every echelon.

4. The policy of keeping surgeons in forward installations informed of the condition of their patients as they were received in installations farther to the rear proved unexpectedly useful from the teaching standpoint and also provided a competitive stimulus. As noted elsewhere (p. 373), this policy was not devoted only to the report and correction of errors. Quite as much attention was devoted to outstandingly good results achieved by special techniques of management.

5. Major Snyder frequently demonstrated the techniques of combat surgery to newly arrived units without previous medicomilitary experience. Early in the war, this proved a rapid and useful method of teaching and one which was frequently requested, particularly in thoracic and thoracoabdominal injuries. As the war progressed, this sort of teaching became unnecessary, because there had come into existence a sound nucleus of qualified surgeons capable of doing surgery on every kind of combat-incurred wound and doing it well. Major Snyder continued, however, to assist during rush periods, as on his numerous visits to the Anzio beachhead (p. 410).

6. Before any division was sent into combat, a meeting was held with all its medical officers. The discussions particularly concerned the special medical necessities of the offensive about to be undertaken, any new methods to be employed, and the errors to be avoided. During rest periods, meetings with the same personnel permitted critiques of the medical performance in the offensive just concluded.

7. When a hospital was found to be weak in a particular department, such as thoracic surgery or orthopedic surgery, standards could be elevated and care of the wounded improved by placing a qualified team from an auxiliary surgical group in the hospital for a sufficient period of time to permit training of the assigned personnel in that specialty.

8. Contacts between forward and base surgeons proved to be highly educational. Arrangements were therefore made, as circumstances permitted, for officers in base hospitals to go forward to observe special types of surgery, such as chest surgery, at first hand in more forward hospitals.

9. Special visits of instruction by medical officers particularly qualified in certain subjects provided another highly practical means of indoctrinating medical officers in correct use of established techniques and in new techniques. Among these visits were the following:

Lt. Col. Harvey S. Allen, MC, spent several weeks in army hospitals in 1944 lecturing on hand surgery and the correct splinting of wounds of the hand.

Lt. Col. Oscar P. Hampton, Jr., MC, lectured on, and demonstrated, the correct techniques of surgery and splinting in wounds of the extremity. This was in February 1944. Later in the year, Colonel Hampton and Maj. Champ Lyons, MC, worked in one hospital for 6 weeks, demonstrating surgery of the extremities, with special emphasis on adequate debridement, correct splinting, the liberal use of whole blood, and the correct use of penicillin.

This agent was just becoming available for general use, and its limitations as well as its potentialities were stressed. Later, these officers conducted seminars on the same subjects in all the other evacuation hospitals in the theater.

In the fall of 1944, an extended tour of Fifth U.S. Army medical installations by Col. Eldridge H. Campbell, Jr., MC, was of great value in the development of the neurosurgical program. Colonel Campbell, who was then serving as acting consultant in neurosurgery, devoted much of his time to the management of peripheral nerve injuries; casualties with intracranial wounds, with particular reference to their transportability; and spinal cord injuries.

On 28 October 1943, Capt. (later Maj.) Floyd H. Jergesen, MC, began to work in the evacuation hospitals on the Garigliano Front and at Anzio for periods of from 5 to 14 days in each hospital. Captain Jergesen, who was serving as consultant in orthopedic surgery to the Surgeon, Fifth U.S. Army, demonstrated surgery of the extremities, with particular emphasis on thorough excisional surgery, fasciotomy, and dependent drainage. His activities grew out of the high incidence of clostridial myositis in Italy at the time. All hospitals were instructed at this time to notify him of all cases of actual or suspected gas gangrene. For the next several months, Captain Jergesen saw every case which developed in Fifth U.S. Army hospitals, as well as many cases which developed in base hospitals.

By July 1944, the Mediterranean theater had ceased to receive new hospitals and new divisions, and there was therefore no further need to train inexperienced organizations and personnel. Most of the lessons of wartime surgery that had been learned in Africa, Sicily, and the early fighting in Italy had by this time been very well learned indeed.

Major improvements in the surgical care of casualties were not confined to any single echelon in the medical service. Educational activities had extended from battalion aid stations through evacuation and convalescent hospitals, and improvements were equally widespread. The improvements were, in part, the consequence of the increased experience of individual medical officers and other personnel in combat surgery, but they were also, to a large degree, the result of the intensive and carefully planned educational program, which had extended through the whole medical service of the Army. In this program, the role of each echelon of medical care was clearly defined, and their relations with each other were indicated with equal clarity.

Circulars and Circular Letters

Circular letters in one sense proved the most useful method of all of disseminating information, for they specified official policy, leaving no excuse for misunderstanding.

Some of these letters were prepared almost as emergencies, in response to needs which were evident and highly urgent. Thus, the first circular letter from the Office of the Surgeon, Headquarters, II Corps, which dealt with the

treatment of casualties, was prepared by Major Snyder after his first inspection of the work of surgical teams in clearing stations in North Africa early in 1943.[4]

The second circular letter from this headquarters, which dealt with gas gangrene and which was published in August 1943,[5] was precipitated by the alarming incidence of clostridial myositis in the Sicilian campaign. Medical circulars on this same subject were necessary from the Office of the Surgeon, Headquarters, Fifth U.S. Army, in October 1943,[6] shortly after the landings at Salerno, and in May 1947.[7]

Another circular letter from the Office of the Surgeon, Headquarters, II Corps, published early in August 1943, was devoted to the care of the wounded in Sicily.[8] It was prepared at the conclusion of the tour of medical installations on that island made by Colonel Churchill, Lt. Col. (later Col.) Perrin H. Long, MC, and Major Snyder. The necessity for it was explained in the introduction, as follows:

1. Introduction.

a. Surgical procedures in the present campaign indicate that many of the lessons learned in Tunisia are not being universally applied in Sicily. Rules and recommendations are not expected to replace the exercise of individual judgment by the surgeon or provide for exceptional circumstances. Deviation from certain basic principles, however, is not acceptable when based on inexperience or unfamiliarity with those principles.

This letter dealt with basic principles of management of the wounded which remained substantially unchanged throughout the war.

Medical circulars from the Office of the Surgeon, Headquarters, Fifth U.S. Army, dealt with trenchfoot;[9] sulfonamide therapy;[10] the disposition of battle casualties in forward echelons, based on careful triage at the clearing station;[11] blood transfusions;[12] and the correct use of Pentothal sodium (thiopental sodium) anesthesia,[13] from which a regrettable number of deaths were occurring. Several of these circulars were prepared by the surgical consultant, with the assistance of appropriate officers qualified in the particular field in question, and the consultant assisted in the preparation of those which he did not prepare himself.

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[4] Circular Letter No. 1, Office of the Surgeon, Headquarters, II Corps, 12 May 1943, subject: Treatment of Casualties.

[5] Circular Letter No. 2, Office of the Surgeon, Headquarters, II Corps, 5 Aug. 1943.

[6] Medical Circular No. 4, Office of the Surgeon, Headquarters, Fifth U.S. Army, 20 Oct. 1943, subject: Gas Gangrene.

[7] Medical Circular No. 9, Office of the Surgeon, Headquarters, Fifth U.S. Army, 5 May 1944, subject: Anaerobic Infections.

[8] Circular Letter No. 3, Office of the Surgeon, Headquarters, II Corps, 7 Aug. 1943.

[9] Medical Circular No. 6, Office of the Surgeon, Headquarters, Fifth U.S. Army, 24 Nov. 1943.

[10] Medical Circular No. 1, Office of the Surgeon, Headquarters, Fifth U.S. Army, 21 Jan. 1944.

[11] Medical Circular No. 4, Office of the Surgeon, Headquarters, Fifth U.S. Army, 7 Apr. 1944, subject: The Disposition of Battle Casualties in Forward Echelons.

[12] Medical Circular No. 10, Office of the Surgeon, Headquarters, Fifth U.S. Army, 6 May 1944.

[13] Medical Circular No. 7, Office of the Surgeon, Headquarters, Fifth U.S. Army, 22 Apr. 1944, subject: Pentothal Sodium Anesthesia; Blood Transfusions; Post Mortem Examinations.

MEETINGS AND CONFERENCES

Meetings and conferences in the Fifth U.S. Army were of various kinds, in addition to the staff meetings, already described, in the hospitals which Major Snyder visited on his tours (p. 358). These conferences were usually held at the end of his visit. Meetings were also held whenever he visited a hospital accompanied by any of the distinguished visitors to the theater (p. 368).

Some hospitals held weekly staff conferences for their own personnel. An excellent series of this sort was conducted at the 16th Evacuation Hospital, where Lt. Col. (later Col.) Manuel E. Lichtenstein, MC, Chief of Surgery, held weekly conferences, almost without exception throughout the war.

Frequent informal meetings and group discussions were held with the visitors to the theater and with others. They ranged in size and formality from discussions in pyramidal tents late at night (with half a dozen officers huddled around a potbellied stove) through surgical clinics and ward rounds (which could be set up at any time) to the Fifth U.S. Army Medical Conferences, at which more than 300 medical officers were often in attendance.

Informal Meetings

The following meetings are typical of the informal, unscheduled meetings held at irregular intervals, in various medical installations in the army area, as the place and the person came together.

In November 1943, Col. L. Holmes Ginn, Jr., MC, Captain Jergesen, and Major Snyder talked to the medical staff of the 3d Division at the clearing station near Riardo. Their presentation and the discussion which followed ranged widely, covering emergency and transportation splinting; the management of shock; the arrest of hemorrhage, with special reference to the use of tourniquets; the correct use of morphine; and sucking chest wounds and abdominal wounds.

On 2 December 1943, Major Snyder talked to the surgical section, 8th Evacuation Hospital, on wounds in general, wou. ds of the chest and abdomen, and shock and hemorrhage. On 11 December, at an all-day session at the 15th Medical General Laboratory, presided over by Col. Virgil H. Cornell, MC, its commanding officer, Colonel Churchill spoke on the prophylaxis of wound infection and the principles of wound management. Captain Jergesen, Maj. (later Lt. Col.) Fiorindo A. Simeone, MC, and Major Snyder spoke on gas gangrene. On 15 December, Major Snyder talked to the 3d Platoon, 33d Field Hospital, on wound excision, vascular injuries, amputations, and shock. On 28 December, at a meeting held at the 1st Platoon of the 33d Field Hospital near Venafro, Maj. (later Lt. Col.) Samuel A. Hanser, MC, discussed the duties of a chief of surgery in a field hospital. Major Snyder compared them to the responsibilities of a senior resident on a surgical service, who must make rounds on all patients and be responsible to the chief of surgery (here Major Snyder) for the quality of the surgery done by all assistant residents; that is, the sur-

gical teams attached to the hospital. This meeting was held to the sound of guns; the U.S. Long Toms were 500 yards behind the field hospital, which meant—as had happened on one of Major Snyder's previous visits—that if an enemy shot at our artillery fell short, the hospital would be hit.

On 24 February 1944, a meeting at the 38th Evacuation Hospital was devoted to chest injuries, with special reference to the management of wet lung, the use of atropine and morphine, and intercostal and paravertebral procaine hydrochloride (Novocain) block. The speakers included Lt. Col. Paul W. Sanger, MC; Maj. Thomas H. Burford, MC; Maj. Benjamin Burbank, MC; and Capt. Arthur J. Adams, MC.

On 20 March, anaerobic infection, with particular reference to gas gangrene, was discussed at a meeting at the 21st General Hospital. Participants, in addition to Colonel Churchill and Major Snyder, included Colonel Hampton, Maj. (later Lt. Col.) Tracy B. Mallory, MC; Capt. Louis DeS. Smith, SnC; Major Lyons, Major Simeone, and Captain Jergesen. On 22 March, at the 23d General Hospital, Lt. Col. (later Col.) Michael L. Mason, MC, spoke on injuries of the hand.

On 25 March, at the 401st Evacuation Hospital (French), the meeting was presided over by General Hugenot, Chief Surgeon, French Medical Corps, and Maj. Etienne Curtillet was one of the participants in the animated discussion devoted to Pentothal sodium. The French regarded this agent as contraindicated in shock, hemorrhage, and chest and maxillofacial wounds. They used it in head injuries but not in abdominal injuries.

On 30 March, at Marcianise, Major Snyder talked to the 2d Auxiliary Surgical Group on triage at the division clearing station, surgery in field hospitals, and chest surgery in field and evacuation hospitals. On 31 March, at the 52d Station Hospital, the discussion concerned surgery in forward hospitals and wounds of the chest. On the same day, a special meeting was held with the thoracic surgeons of the 2d Auxiliary Surgical Group on the indications for chest surgery in forward hospitals.

On 7 May, Major Snyder addressed the entire staff of the 33d Field Hospital on a number of subjects, including blood transfusions and the management of anuria. Many surgeons expressed themselves as afraid to use potassium chloride, as advocated by Lt. Col. (later Col.) Marion H. Barker, MC, Chief of Medicine, 12th General Hospital, because of its possible toxic effect on the heart.

Fifth U.S. Army Medical Conferences

The Fifth U.S. Army Medical Conferences were the only formal medical conferences held in the Fifth U.S. Army area. They were instituted by General Martin in November 1943, when the army headquarters was located in the palace at Caserta; here, the meetings were held in the Royal Opera House. When headquarters moved forward, the conferences were held in one or another of the evacuation hospitals.



FIGURE 65.—Brig. Gen. Joseph I. Martin, Surgeon, Fifth U.S. Army, addressing rehabilitation conference at Castel Fiorentino, Italy, in 1945. Lt. Col. Howard E. Snyder is seated on the general's right.

These meetings proved an extremely valuable means of disseminating information on surgical subjects, particularly during the first winter in Italy, when the educational needs were greatest. At this time, the front was generally stable, and army medical installations were not too widely scattered. The conferences could therefore be attended by medical officers of all echelons in the army area, as well as by many from station and general hospitals supporting the army. At the 17 February 1944 meeting, when peripheral vascular lesions were discussed, the audience overflowed the tent and attendances of 250 or 300 were not unusual.

The Fifth U.S. Army surgical consultant planned all surgical programs. The speakers were selected because of their grasp of important current problems or their proficiency in special fields. General Martin, Surgeon, Fifth U.S. Army, presided at almost all of the conferences, which he ran with efficiency and dispatch (fig. 65). At his request, Major Snyder always closed the discussions on surgical subjects, making certain that accepted principles, as they were laid down officially, were clearly delineated. The only form of censorship exercised at these meetings, in fact, was Major Snyder's insistence that no policies and practices be advocated which did not conform with those approved by the theater and army surgeons.

Discussions from the floor were always animated and were frequently very useful. At the 4 November 1943 meeting, for instance, when the subject was gas gangrene, Maj. (later Lt. Col.) Henry K. Beecher, MC, discussed anesthesia in this condition. During the discussion at the 25 November meeting, the general subject of which was anesthesia, it was brought out that Pentothal sodium had been employed too freely, and its use in head injuries was condemned.

With occasional exceptions, these Fifth U.S. Army conferences were held weekly from their institution in November 1943 until shortly before the fall of Rome in June 1944. Most of them were on surgical subjects, but a few were devoted to other subjects, including neuropsychiatric casualties, typhus fever, pneumonia, infectious hepatitis, and malaria.

Table 6 gives some idea of the range of the material covered at these conferences and the outstanding caliber of those who made the presentations.

There was general regret when tactical circumstances made it impossible to continue these conferences, and there was universal agreement that they had served their purpose well.

Other Meetings

On 11 February 1944, at a meeting of the Peninsular Base Section Medical Society in Naples, Captain Jergesen and Major Snyder spoke on clostridial myositis, and Maj. (later Lt. Col.) Benjamin W. Rawles, Jr., MC, and Maj. Harvey S. Allen, MC, spoke on burns. Brig. Gen. Leon A. Fox, MC, spoke on typhus. By the time this meeting was held, the Naples epidemic, which had reached its peak in the middle of January, had been conquered. More than 1,500,000 men had been dusted with delousing powder in the course of the campaign. The mildness of the single case of the disease which occurred in an American soldier was attributed to his vaccination.

Major Snyder attended the Congress of the Central Mediterranean Force Army Surgeons, held in Rome from 12 to 19 February 1945, together with other medical officers from the Fifth U.S. Army and the theater. The whole field of war surgery was covered, and special sessions were devoted to wounds of the chest and wounds of the abdomen. The closing address was made by Maj. Gen. Morrison C. Stayer, Surgeon, MTOUSA (Mediterranean Theater of Operations, U.S. Army). He emphasized, as did his opposite number, Maj. Gen. William C. Hartgill, C.B., O.B.E., M.C., K.H.S., that war surgery in the Mediterranean theater had been a pooled experience, with British and American medical personnel part of one team and with patients from all the Allied armies treated in forward hospitals as if they too belonged to one team. General Hartgill particularly stressed the fact that in this war the wounded man was not brought back to the surgeon; rather, the surgeon was brought up to the wounded man, and his chances of life were thus increased manyfold.

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TABLE 6.—*Presentations at Fifth U.S. Army Medical Conferences*

Date	Subject	Speaker
4 November 1943	Gas gangrene	Capt. Floyd H. Jergesen, MC, 2d Auxiliary Surgical Group. Capt. Robert W. Augustine, MC, 38th Evacuation Hospital. Lt. Col. Kenneth F. Ernst, MC.
11 November 1943	Chest wounds	Maj. Henry K. Beecher, MC, NATOUSA. Maj. Lawrence M. Shefts, MC, 2d Auxiliary Surgical Group. Capt. Lyman Brewer, MC, 94th Evacuation Hospital. Maj. Daniel A. Mulvihill, MC, 15th Evacuation Hospital.
18 November 1943	Abdominal wounds	Maj. Howard A. Patterson, MC, 95th Evacuation Hospital. Maj. James M. Mason III, MC, 2d Auxiliary Surgical Group.
23 November 1943	Anesthesia	Capt. John M. Beffel, Jr., MC, 15th Evacuation Hospital. Maj. Henry K. Beecher, MC, NATOUSA. Major Howell, RAMC, 14th Casualty Clearing Station.
2 December 1943	Fractures	Maj. Howard E. Snyder, MC, Fifth U.S. Army. Capt. Floyd H. Jergesen, MC, 2d Auxiliary Surgical Group.
23 December 1943	Head injuries	Maj. William R. Pitts, MC, 38th Evacuation Hospital. Maj. Laurence M. Weinberger, MC, 16th Evacuation Hospital.
30 December 1943	Maxillofacial injuries	Maj. Samuel G. Balkin, MC, 94th Evacuation Hospital. Captain Rehfield, MC, 36th General Hospital. Col. Egbert W. VanD. Cowan, MC, Fifth U.S. Army.
6 January 1944	Trenchfoot	Maj. John Parke, MC, 109th Medical Battalion. Capt. Sidney Galt, MC, 56th Evacuation Hospital. Capt. William F. Hickey, Jr. MC, 3d Convalescent Hospital.
13 January 1944	Shock and hemorrhage	Maj. Charles S. Rife, MC, 94th Evacuation Hospital. Maj. James M. Sullivan, MC, 2d Auxiliary Surgical Group.

TABLE 6.—*Presentations at Fifth U.S. Army Medical Conferences*—Continued

Date	Subject	Speaker
20 January 1944	The prevention of infection in war wounds.	Lt. Col. Michael L. Mason, MC, 12th General Hospital. Lt. Col. Sigurd C. Sandzen, MC, 94th Evacuation Hospital.
3 February 1944	Treatment of battle fractures in base hospitals.	Maj. Oscar P. Hampton, Jr., MC, 21st General Hospital. Maj. Howard E. Snyder, MC, Fifth U.S. Army.
10 February 1944	Secondary wound closure.	Maj. Harvey S. Allen, MC, 12th General Hospital. Maj. John Burke, MC, 23d General Hospital. Lt. Col. Langdon Parsons, MC, 52d Station Hospital.
17 February 1944	Vascular injuries	Capt. Byron H. Evans, MC, 94th Evacuation Hospital. Lt. Col. Manuel Lichtenstein, MC, 16th Evacuation Hospital. Maj. Fiorindo A. Simeone, MC, NATOUSA.
24 February 1944	Chest injuries	Lt. Col. Paul W. Sanger, MC, 38th Evacuation Hospital. Maj. Thomas H. Burford, MC, 2d Auxiliary Surgical Group. Maj. Benjamin Burbank, MC, 2d Auxiliary Surgical Group. Capt. Arthur J. Adams, MC.
2 March 1944	Occurrence of heart failure in blast injury.	Capt. Byrd S. Leavell, Jr., MC, 8th Evacuation Hospital.
9 March 1944	Spinal cord injuries	Capt. Wolfgang W. Klemperer, MC, 2d Auxiliary Surgical Group. Maj. John E. Webster, MC, 36th General Hospital. Maj. Henry G. Schwartz, MC, 21st General Hospital.
6 April 1944	Hemoglobinuria nephroses.	Maj. Tracy B. Mallory, MC, 15th Medical General Laboratory.
	Transfusion reactions	Maj. John J. McGraw, MC, 15th Medical General Laboratory.
	Blood banking for a field army.	Maj. Eugene R. Sullivan, MC, NATOUSA.
20 April 1944	Injuries of the hand	Lt. Col. Michael L. Mason, MC, 12th General Hospital.
4 May 1944	Gas gangrene	Capt. Floyd H. Jergesen, MC, 2d Auxiliary Surgical Group.
11 May 1944	Wounds of the extremities.	Lt. Col. Oscar P. Hampton, Jr., MC, NATOUSA.
	Penicillin	Maj. Champ Lyons, MC, NATOUSA.

VISITORS TO THE ARMY AREA

The visits to the Fifth U.S. Army area of Col. Edward D. Churchill, MC consultant in surgery to the theater surgeon, were always welcome and helpfu Earlier, in July 1943, in the course of the Sicilian campaign, Colonel Churchil Lt. Col. Perrin H. Long, MC, Consultant in Medicine to the Surgeo NATOUSA, and Major Snyder, Consultant in Surgery, II Corps, made a tou of all II Corps medical installations and all Seventh U.S. Army medical in stallations as far to the rear as Palermo. The divisions of the Corps, unde the command of Lt. Gen. (later Gen.) Omar N. Bradley, were making suc rapid progress across the island that medical evacuation and supply were som times rather difficult. The installations visited included battalion aid st tions, collecting and clearing stations, field hospital platoons, and 400-bed an 750-bed evacuation hospitals. The circular letter prepared at the conclusio of this tour has already been described (p. 361).

On this visit, as in all others, Colonel Churchill's high standards were r flected in improvement in the work of the installations visited and in the e cellent quality of all the surgery finally done in this theater. The repor which he published for the information of theater and army surgeons an which he submitted to the Office of the Surgeon General were equall helpful.[14]

In the spring of 1943, Dr. Allen O. Whipple, professor of surgery at t Cornell Medical School, spent some time in Tunisia, on his return from t Middle East, where he had been observing the work done in British hospital His clinical observations on delayed primary wound closure and penicillin a discussed elsewhere (p. 425). In company with Major Snyder, he visited man of the installations at the Bizerte medical center, and both of them addresse members of the 2d Auxiliary Surgical Group, which was then stationed ther

Col. Johan M. Holst, Surgeon-General of the Norwegian Army and pr fessor of medicine and director of the surgical clinic at the University of Osl made an extended stay in the Fifth U.S. Army area in the winter of 1944. H visited many of the hospitals in the army area, including those on the Anz beachhead. His talks, which were all informal, were of great value.

Visitors from the European theater before D-day in that theater include Col. (later Brig. Gen.) Elliott C. Cutler, MC, Chief Consultant in Surgery the Office of the Chief Surgeon, ETOUSA, who had recently returned fro Russia and who had much interesting and useful information about medic practice there; Lt. Col. (later Col.) Ralph M. Tovell, MC, Consultant Anesthesia; Col. Kenneth D. A. Allen, MC, Consultant in Radiology; an Col. James Snyder, MC, Executive Officer, First U.S. Army. Brig. Gen. Fre

[14] Before Colonel Churchill assumed his duties as consultant in surgery to the Surgeon, NATOUS in March 1943, much useful advice and assistance were received from Lt. Col. Frank B. Berry, M chief of the surgical service of the 9th Evacuation Hospital, the affiliated Roosevelt Hospital un As long as Colonel Berry remained in the theater (until August 1944, when he participated in t invasion of southern France as chief surgical consultant for the Seventh U.S. Army), Colonel Snyd found his associations with him very helpful in his own work.

W. Rankin, Director, Surgical Consultants Division, Office of the Surgeon General, visited the Mediterranean theater in 1944, and in the spring of 1945 Lt. Col. Michael E. DeBakey, MC, Chief, Surgical Branch, Surgical Consultants Division, Office of the Surgeon General, was another visitor.

During the first winter of the war in Italy, the 36th General Hospital was stationed at Caserta, immediately adjacent to Fifth Army headquarters. Its close proximity made it possible to utilize the advice of the many competent surgeons on the staff, including Lt. Col. James M. Winfield, MC, Chief of Surgery, and Maj. (later Lt. Col.) William M. Tuttle, MC, thoracic surgeon. At this time, medical officers from the 12th General Hospital were attached to the 36th General Hospital, and their services were also utilized. Among them were Lt. Col. Michael L. Mason, MC, Chief of Surgery, and Maj. (later Lt. Col.) Harvey S. Allen, MC, hand surgeon. These officers made major contributions to the evolution of policies of medical management in the Mediterranean theater.

During the second winter of the war in Italy, the 24th General Hospital was stationed in Florence, and, again, it was possible to make use of the advice of the many excellent surgeons on the staff, among them Lt. Col. (later Col.) Francis J. Cox, MC, Chief of Surgery, who was an experienced orthopedic surgeon, and Maj. (later Lt. Col.) Bently P. Colcock, MC, a general surgeon.

While the 24th General Hospital was stationed in Florence, seriously wounded casualties were evacuated to this general hospital when they left field and evacuation hospitals. At one time during the winter of 1944–45, this hospital had 60 patients with colostomies on one ward. The proximity of the general hospital to the army hospitals often made it possible for the surgeons in the general hospital to confer with the surgeons who had performed the initial wound surgery in the cases they were then treating.

The visits of all of these medical officers and professional men to the Fifth U.S. Army area and the contacts possible with officers in the base hospitals contributed materially to the studious and scientific approach to the problems of war surgery which characterized all medical organizations in that army.

EVALUATION OF SURGERY

North Africa

Major Snyder's first evaluation of oversea surgery was in the North African theater, when he was placed on temporary duty in II Corps headquarters for this particular purpose. His report to the Surgeon, II Corps, on 3 April 1943 was based on his observations in the following installations:

1. The French Hospital in Gafsa, in a II Corps clearing station, set up and staffed by the 1st Platoon, Company D, 51st Medical Battalion. The organic personnel of the platoon was supplemented by two general surgical teams and one shock team from the 2d Auxiliary Surgical Group.

2. The 2d Platoon of the Clearing Company, 1st Medical Battalion, also at Gafsa.

3. The treatment stations of Company A and Company C, 47th Medical Battalion (1st Armored Division), at Maknassy Road.

4. The treatment station of Company B, 2d Battalion, 16th Medical Regiment, Maknassy Road. One general surgical team from the 2d Auxiliary Surgical Group was attached to this installation.

Casualties from the 1st Division evacuated on the El-Guettar-Gafsa Road were sorted at the clearing station of the 1st Medical Battalion, at which they arrived between 1 and 5 hours after wounding. Nontransportable casualties and severely wounded casualties were transferred immediately to the clearing station of the 51st Medical Battalion. Other casualties were sent on to the 48th Surgical Hospital (fig. 66), 50 miles to the rear.

Casualties from the Maknassy area passed first through the treatment stations of the 47th Medical Battalion, 1st Armored Division, then through the clearing station of the 51st Medical Battalion, at which they arrived from 5 to 24 hours after wounding. Here they were sorted, the nontransportable being held for surgery there and the remainder being sent back to the 48th Surgical Hospital.

Sorting was generally well done, and as a result surgical personnel in the clearing stations could utilize their time in the care of only the seriously wounded. For the most part, excellent judgment was also used in the selection of cases for surgery by the teams of the 2d Auxiliary Surgical Group, and the surgery performed was generally commendable.

The 48th Surgical Hospital, as just mentioned, received the presumably less seriously wounded casualties who were regarded as fit for evacuation before undergoing surgery and also received casualties evacuated after having undergone surgery in the clearing stations.

The 21 deaths which occurred at this installation revealed some grounds for criticism, as follows:

1. Among the 32 patients operated on at the 51st Medical Battalion, 4 deaths occurred from 5 to 27 hours after operation (2 other patients died before evacuation). It was concluded that less speedy evacuation of patients who had undergone surgery might have saved some lives. A number of these men had been evacuated before they had reacted from anesthesia.

2. At the other extreme, 10 deaths occurred in patients who had passed through the clearing stations forward but had not received surgery in them. It was concluded that a few of these lives might have been saved if primary surgery had been performed earlier at the forward installations.

3. Of the seven remaining deaths, five occurred in patients who had passed through other clearing stations without surgery and two in patients who had reached the hospital from a battalion aid station and a collecting company, respectively.

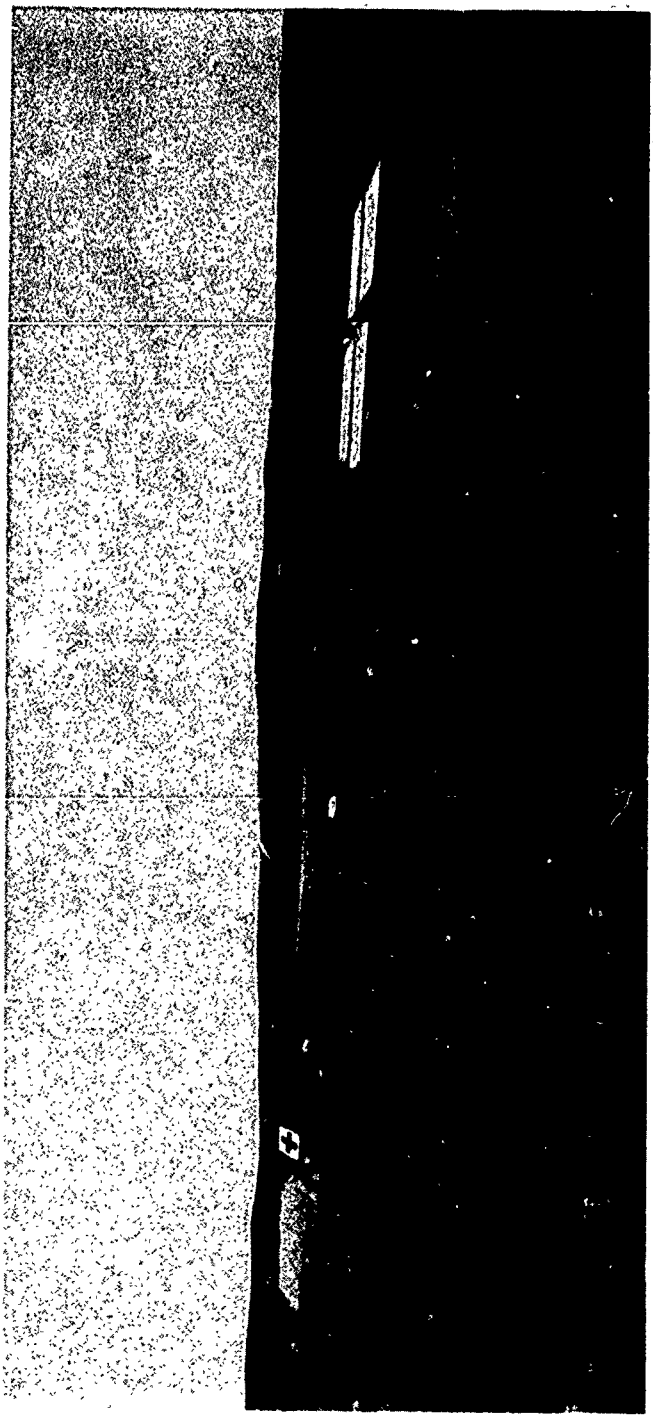


FIGURE 66.—The 48th Surgical Hospital, North Africa.

The following recommendations with respect to other subjects were made:

1. A more convenient method of blood transfusion should be made available.

2. A source of blood other than clearing station personnel should be provided.

3. Provision should be made for oxygen therapy.

4. A shock team from the auxiliary surgical group should be assigned to every clearing station set up to act as a forward surgical hospital.

5. An orthopedic surgery team, or at least an orthopedic surgeon, would add greatly to the efficiency of each forward surgical installation.

6. Caution should be used in the administration of morphine. An analysis of the records suggested that overlarge doses of morphine might have played a part in some of the fatalities, while other records seemed to point to the same conclusion, though they bore no notation concerning administration of the drug. It was suggested that a directive be issued warning against any but small doses of morphine in chest injuries, prohibiting its use entirely in intracranial injuries, and outlining other precautions in its administration.

Excessive morphine dosage was a well-recognized clinical problem from the beginning of the war. Whenever Major Snyder talked to medical officers and corpsmen and to division medical services, he always advised that a half Syrette be administered rather than the full (grain ½) Syrette dose. Necessary instructions concerning the judicious use of morphine were contained in Circular Letter No. 1, Office of the Surgeon, Headquarters, II Corps, dated 12 May 1943, concerning the treatment of casualties, and specific instructions concerning the dangers of overdosage were given before the invasion of Italy.

The importance of this problem was particularly evident in the 100th Infantry Battalion (Separate), made up of American-born Japanese from Hawaii and the Philippine Islands as well as a small number of native-born Japanese. The same problem was encountered in the 442d Infantry Regiment (Separate). Japanese are so small that even the reduced amount of morphine received from half a Syrette affected them much more than it did U.S. troops, who were taller and heavier.

7. More explicit instructions should be issued concerning the emergency treatment of head and chest wounds, as well as the disposition of these casualties. Casualties observed in the clearing stations and the 48th Surgical Hospital, as well as the records studied, indicated that specialty teams for the treatment of head and chest injuries should be located nearer to the front than evacuation hospitals, at least as these hospitals were then located. The 48th Surgical Hospital was between 50 and 85 miles from the main battlefront at various times, and the 9th and 77th Evacuation hospitals were between 60 and 145 miles behind it.

Recommendations concerning anesthesia and equipment (p. 392) were also included in this report, in which it was noted that the recommendations concerning clearing stations were intended to apply only to those set up to act as

forward surgical hospitals. With this report, Major Snyder submitted a short treatise on the emergency care of wounded in forward installations. One of the points repeatedly emphasized was that provisions must be made in whatever installation major surgery was performed to hold the patient for a safe period of time afterward.

Sicily

Major Snyder's initial observations in Sicily showed that surgery was, on the whole, good, and some of it was extraordinarily good. On the other hand, surgeons without previous experience in combat-incurred wounds were doing inadequate initial wound surgery (debridement) and thus were responsible for at least some of the clostridial myositis which was then causing a great deal of concern (p. 445). Here, as all through the Italian campaign, it seemed inevitable that when new hospital units came into the theater they must acquire experience by making mistakes before uniformly good surgery could be expected from them. Many surgeons required time to learn the importance, for instance, of a bold approach to a wound and the necessity for an incision of sufficient length to permit adequate exposure of the wound depths.

The circular letter issued from the Office of the Surgeon, Headquarters, II Corps, on 7 August 1943, was designed to correct these and other errors, some of which could be traced to an earlier circular letter issued from the Office of the Surgeon, Headquarters, NATOUSA.[15] The most important of these errors was the direction that all wounds, *without exception*, be left open.

Italy

As the war progressed, it was found that one of the most useful means of evaluating the quality of the surgery done in forward installations was by examination of casualties after they had reached base hospitals. After this plan was adopted, Major Snyder made it his practice to make notes on special cases, attempting to select those in which results had been outstandingly good as well as those in which errors had been made or complications had developed or the subsequent course indicated that the procedure at initial wound surgery was not too well advised or had been inadequate.

By this means, it was possible to determine the quality of surgery done in forward hospitals and to identify the units, and even the individual surgeons, whose technique and judgment either required correction or had been unusually good. These data were given to the surgeon concerned or to his surgical chief.

From the beginning, medical officers in the Fifth U.S. Army manifested an unusual interest in following up their patients in order to evaluate the procedures carried out on them in forward echelons. This was as true of the battalion surgeons and surgeons in clearing and collecting stations as of those in field

[15] Circular Letter No. 16, Office of the Surgeon, Headquarters, NATOUSA, 9 June 1943, subject: Memoranda on Forward Surgery Especially Applicable to Amphibious Operations.

and evacuation hospitals. Opportunities were provided, as far as possible, to capitalize on this interest by permitting surgeons from forward installations to visit fixed hospitals in the base.

During certain phases of the Italian campaign, there were unusually good opportunities to follow up patients operated on in the combat zone. On the Cassino front, for instance, field and evacuation hospitals were located near each other, and base hospitals were established in nearby Caserta and at Naples. The close physical proximity of army and base installations provided exceptional opportunities for informal exchanges of visits and for the weekly army conferences. It was thus possible to study the management of wounds, assess the work performed in each organization, correct errors, and promulgate for early adoption whatever new surgical techniques had been developed.

Similarly, during the offensive against the Gothic Line in the spring of 1944, the 24th General Hospital was located in Florence, within the army area, and another excellent opportunity was provided for chiefs of surgery in field and evacuation hospitals, as well as other medical officers, to follow up their cases.

EVACUATION

The successful utilization of field and evacuation hospitals in the army area depended upon successful triage (the selection of patients for surgery on the basis of priorities). Triage, which was carried out at the division clearing station, was based upon the following considerations: (1) Care of nontransportable casualties in field hospital platoons placed adjacent to division clearing stations and with their intrinsic personnel augmented by auxiliary surgical group teams and (2) evacuation of transportable casualties from clearing stations to evacuation hospitals farther to the rear.

Evacuation hospitals were set up in depth along the main axis of advance in the zone which they were supporting. Early in 1944, it became the duty of the corps surgeon and the medical units under him, chiefly the corps medical battalions which handled evacuation from division areas to army hospitals, to execute triage of transportables. Efforts were made to keep the hospitals nearest to the front free for the care of the more urgent cases, while casualties with less urgent wounds were sent to the rearmost hospitals. It was also the policy to send the mainstream of casualties who could withstand prolongation of transportation to the rear during daylight hours and to use the more forward hospitals at night, to reduce the hazards of driving in the blackout.

It had been repeatedly demonstrated in North Africa and Sicily, as it was evident until the end of the war, that the placing of field hospital platoons immediately adjacent to clearing stations not only simplified transportation of seriously wounded casualties from one installation to the other but actually saved many lives. Corps headquarters therefore always made every effort to place these units as close together as the terrain and the tactical situation permitted.

Facilities for Evacuation

As in all previous wars, litter carries and ambulances furnished the principal means of evacuation from the frontline to the battalion aid station and thence to clearing stations. On flat terrain, this presented only the usual difficulties. In mountain warfare, the situation was often extremely difficult. Some casualties were moved by mule pack, others by cables strung between mountain peaks. Nothing, however, took the place of litter bearers in mountain fighting. Those from a battalion aid station often had to evacuate casualties to the rear to ambulance collecting points, and litter bearers from collecting companies had to work forward and assist in collecting casualties from the battlefield. Even with Italian soldiers to assist, it was necessary to ask Allied Forces headquarters to allot 100 litter bearers above the number allotted by the table of organization for each division engaged in mountain warfare.

Evacuation from the Anzio beachhead, which also furnished special difficulties, is described elsewhere (p. 347). The decision concerning where the casualty should be delivered from the battalion aid station rested with the division surgeons. Most of them directed that patients be taken to the collecting station.

From the standpoint of conservation of drivers, this was a desirable arrangement. The approach from the aid station to the collecting station was generally hazardous, and limitation of the number of drivers meant the limitation of the number exposed to enemy observation and fire. If all drivers had made the run from the aid station to the clearing station, all of them would have been subjected to major risks, and more drivers and more ambulances would have been necessary.

Air evacuation began in Sicily about D+5 and proved a safe and expeditious way of removing casualties to the hospitals in North Africa (fig. 67). During the fall and winter of 1944–45, most patients who went to base hospitals were evacuated from Rome or Naples by means of C–47 (civilian DC–3) planes, as a responsibility of the base section.

Air evacuation of individual patients by L–5 planes (fig. 68) was begun experimentally in Italy early in March 1945. Patients had to be selected carefully for this mode of transportation since no medical care was possible during the flight. On the other hand, practically all of those thus transported had had initial wound surgery and were in good condition.

Since ample ambulance facilities were available, these planes were not used widely in the Po Valley campaign, though they were extremely useful in flying blood forward from the blood bank in Florence. They were very useful, however, during the mountain fighting later, as well as still later, when the army broke out into the valley and the medical service had to be spread over hundreds of miles.

Theoretically, the plan was that the base section would evacuate casualties by collecting them at specified holding points in the army area. During most



FIGURE 67.—Air evacuation by converted C–47 transport plane, MTOUSA.

of 1944, the base lacked facilities to implement this plan and the army evacuated casualties either to transfer points designated by the base or directly to base hospitals. During the first 3 months of 1945, it became the policy to hold in army hospitals all patients except those whose conditions demanded treatment which could be secured only in base hospitals. During this period, several general hospitals were located in the army area, and if the patients who had to be evacuated to them could be returned to duty they were channeled back to the army area either through the ordinary agency of replacement companies or through the 3d Convalescent Hospital, Montecatini, Italy.

The holding period in Italy varied from 60 to 120 days, the longer period being permitted when, as at this time (early 1945), the fighting was less active.

Hospital trains were first employed in Italy in November 1943. A typical train was staffed with 4 medical officers, 6 nurses, and 33 enlisted men and could accommodate about 135 litter patients, placed in three tiers in compartments or along the sides, in addition to 215 ambulatory patients.

The railroad equipment first used was defective and the service erratic. Later, when a loading point was established at Caserta and the trains began to be handled by railroad operating personnel with experience in the United States, this became a very satisfactory method of evacuation. The trip from Caserta to Naples, when this method of evacuation had become well developed, took 1½ hours.



FIGURE 68.—Evacuation by L-5 plane from Firenzuola to Florence. A section of the side of the plane opens, permitting a stretcher to be placed on the deck in the rear, where it is securely lashed.

MEDICAL INSTALLATIONS IN THE ARMY AREA

Battalion Aid Station

At the battalion aid station, to which the casualty was brought from the battlefield, surgical measures were limited to those which would render him transportable. They included (1) inspection of the dressings and splintage applied on the battlefield, with such reinforcement or alterations as might be necessary; (2) control of hemorrhage by compression dressings, ligature, or tourniquet as necessary; (3) attention to the airway with, occasionally, the performance of tracheotomy; (4) proper attention to sucking wounds of the chest and relief of tension pneumothorax; and (5) administration of plasma (p. 416).

Minor wounds in casualties who could be promptly returned to duty were also cared for at the battalion aid station.

Collecting Station

The collecting station (fig. 69), whose function is implicit in its name, was regarded by most medical officers as an important point in the division medical service. During 1944, its elimination was advocated in some quarters, but there



FIGURE 69.—Collecting station, 10th Mountain Division, Gothic Line.

were many good reasons for its continuation, and nothing came of these suggestions.

Most casualties were held at the collecting station only long enough to check their condition and render any further first aid necessary. Tourniquets, dressings, and splints were examined, and it was ascertained that the airway was patent. Additional plasma was administered if necessary. The general policy was to do nothing active unless there was a real indication for interference.

The casualty's name and organization and other data required for official records, which had been recorded at the battalion aid station, were checked at the collecting station. Most regimental commanders required that regimental surgeons secure this information from these installations and render complete reports of battle casualties from the regiment. Details secured here concerning the number of casualties, the location of the engagement in which they had been wounded, the type of weapons used, and similar data were usually the first significant information to reach the regimental commander. These data were, of course, invaluable to him in assessing the progress of the battle in which his regiment was engaged. Unless all casualties passed through collecting stations, this highly essential information could not have been secured until the patients had reached the clearing stations farther to the rear, which was often many hours later.

When an offensive was on or when early evacuation was not essential, casualties were usually held in the collecting station until an ambulance load had been accumulated. Those with first priority wounds, such as wounds of

the chest or abdomen, and those in severe shock were often sent back singly, with individual attendants to supervise their care en route when personnel could be spared. This policy reduced the average timelag between wounding and initial wound surgery, but because triage was careful, no evidence was accumulated to suggest that the risk was increased for the casualties held until a full ambulance load was secured.

Occasionally, if the clearing station was close at hand, the collecting station might be bypassed and casualties taken directly from the battalion aid station to the clearing station, but this was never a general policy, regardless of the location of the installations.

Clearing Station

The experience of the Tunisian campaign had persuaded those responsible for the planning of medical care in the Sicilian campaign that facilities for surgery and for adequate postoperative care of casualties submitted to surgery should be established as far forward as the division clearing station. In April 1943, in his report on the use of teams from the auxiliary surgical groups (p. 369), Major Snyder had supported this policy of forward surgical care. He recommended, however, that, when the intrinsic staffs of clearing platoons of corps medical battalions were augmented by auxiliary surgical group teams, the equipment of the platoons also be increased. Their original tables of equipment were not adequate for their new mission.

He further recommended, since the performance of surgery at division clearing stations would interfere with the proper functioning of these installations, that platoons of clearing companies designated to supply surgical care should be set up adjacent to the clearing stations rather than within them. This arrangement would make it possible for the seriously wounded to be operated on promptly but would, at the same time, leave the clearing stations free to perform their basic functions of triage.

From this suggestion, it was only a step to the final arrangement; namely, the use of field hospital platoons, rather than the clearing platoons of medical battalions, for forward surgery.

The principal improvement effected in second echelon medical services in the Fifth U.S. Army in 1944 had to do with the functioning of clearing stations. After an analysis of the 80 deaths which had occurred in Fifth U.S. Army evacuation hospitals in January 1944, Major Snyder concluded that more careful triage in the clearing stations might have directed a larger number of casualties to the field hospital platoon immediately adjacent to them and would probably have led to a reduction in the mortality rate. Of 44 patients in deep shock or with first priority wounds whose case histories he studied, 36 were sent directly to evacuation hospitals from the clearing stations, while the remaining 8, although they were sent to field hospitals, were merely observed there and then were sent to evacuation hospitals for initial wound surgery.

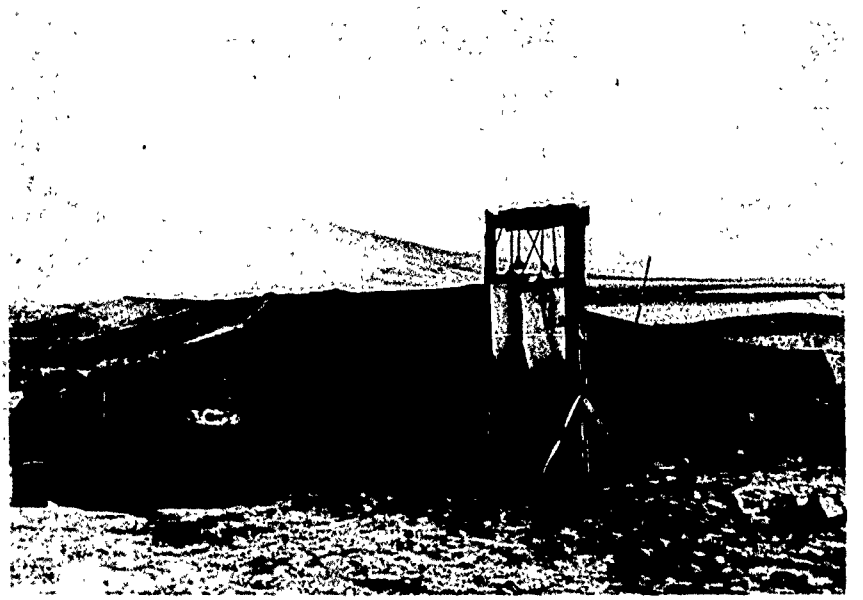


FIGURE 70.—Field hospital, North Africa

These observations led to the institution of an educational program in the clearing stations, based on a medical circular dealing with the disposition of battle casualties in forward echelons.[16] The prompt improvement which occurred in the triage of casualties at clearing stations was maintained until the end of the war.

Field Hospital

When platoons of field hospitals were designated for the performance of forward surgical care in Sicily, they assumed functions quite different from the station hospital type of care which they had provided in North Africa (fig. 70). In Sicily, they were set up immediately adjacent to division clearing stations, the location often being within range of enemy artillery, and they were provided with more surgical equipment than had been given the clearing platoons of medical battalions which had performed forward surgery in North Africa.

The concept of forward surgical care in field hospitals was based on two considerations, as follows:

1. Certain casualties, such as those with abdominal or severe chest wounds and those in deep shock, must receive surgical care at the level of the clearing station if they are to survive.

2. Patients who have been submitted to major surgery must not be moved earlier than 8 or 12 days after operation.

[16] See footnote 11, p. 361.

The care of first priority patients at the level of the clearing station had many advantages. Prolonged evacuation of seriously wounded patients, which was deleterious, was avoided. When the intrinsic staff was augmented by teams from an auxiliary surgical group, the number of surgeons and nurses was proportionately larger in field hospitals than in evacuation hospitals, which meant that seriously wounded casualties could be cared for with less delay and could receive better postoperative care. Segregation of patients with serious wounds permitted closer observation and generally better care. Finally, the establishment of field hospitals at the level of the clearing station proved highly advantageous from the standpoint of troop morale. Every man in a division which was thus supported knew that a hospital staffed with competent surgeons and nurses was located so far forward that, if he were seriously wounded, he would receive superior care with a minimum of delay.

Under exceptional circumstances, when a heavy casualty load had resulted in a backlog of patients in a field hospital, some patients in the group were selected for treatment by resuscitative measures and then were transferred to the nearest evacuation hospital. The objective was to reduce the timelag between wounding and surgery, but the practice was recognized as an undesirable emergency measure and was actively discouraged as a regular procedure.

As a matter of convenience and to avoid repetition, the use of auxiliary surgical group teams in field hospitals is discussed elsewhere (p. 385).

The use of field hospital platoons augmented by teams from auxiliary surgical groups saved the lives of many severely wounded. Because the field hospital was only a short litter carry from the clearing station, many casualties could be operated on who would never have withstood operation after prolonged evacuation to the rear. Mortality rates in field hospitals were high, but they would have been much higher if this forward surgical unit had not existed, and the number of patients with serious abdominal and chest wounds who could be returned to duty after surgery in them and convalescence in base hospitals was really surprising.

Postoperative management.—One of the important surgical lessons of the fighting in North Africa was that patients who had undergone major surgery, particularly abdominal surgery, did not withstand evacuation until 8 or 10 days, and preferably longer, after operation. The postoperative care of these casualties was thus one of the responsibilities of field hospitals (fig. 71).

Holding the patients after operation was a simple matter when the hospital was situated behind a stable front or a slowly advancing front. In these tactical circumstances, one field hospital could serve two divisions in the line by using two of its three platoons at the two division clearing stations while the third platoon held patients at a fixed location until they could be evacuated and it could leapfrog over one platoon or the other when the division clearing stations moved.

With a rapidly moving front, the problem was somewhat more complicated. Then, every division usually required the support of an entire field



FIGURE 71.—Postoperative ward in 1st Platoon, 33d Field Hospital, Italy.

hospital, the platoons of which were set up in depth behind the front. Only the forward platoon, set up beside the division clearing station, received casualties. The other two platoons held postoperative patients in various stages of convalescence until they could be evacuated and these platoons, in turn, could move forward.

When the forward platoon of the field hospital, which was adjacent to the clearing station, was closed to admissions, the rearmost platoon was moved forward to establish treatment facilities beside the clearing station in the latter's new forward position. The platoon which was no longer receiving new patients continued to care for its postoperative patients until they were ready for evacuation. Experience had soon shown that the skeletonized plan originally devised was not adequate. A surgical team had to remain with the holding unit, to care for patients who might require surgery for secondary hemorrhage, wound dehiscence, subdiaphragmatic abscess, clostridial myositis, and other complications. It was also necessary to leave an operating room set up, as well as facilities for radiography and fluoroscopy.

It was sometimes possible to provide postoperative care by moving evacuation hospitals to sites occupied by field hospitals, leaving the platoons of the field hospital free to move forward. This was perfectly satisfactory. The

important consideration was the provision of postoperative care in the installation in which the patient had received surgical care. If casualties were moved too soon after major surgery, the results might easily be worse than if surgery had been postponed until they reached evacuation hospitals. The original tendency had been to regard most patients as rapidly transportable, the emphasis being placed upon the operative act. It was not long before it was realized that complete postoperative care was equally important.

Evacuation Hospital

The evacuation hospital proved the ideal unit in which to provide definitive surgery for the majority of wounded in World War II.

Admissions to evacuation hospitals were mixed, both medical and surgical cases being received, though the medical load was lightened when special hospitals were set up for the treatment of venereal disease and the care of neuropsychiatric casualties. With first priority casualties diverted to field hospitals, the evacuation hospitals were capable of providing excellent surgery, though their accomplishments depended, ultimately, upon the extent and care with which nontransportable casualties had been filtered out in clearing stations and field hospitals. When this task had been well done, an evacuation hospital was capable of caring for 80 surgical casualties per day and could push the number to 100 or more for periods of days in times of stress.

An attempt was always made to balance the number of lightly and seriously wounded in the daily admissions. The officer in corps headquarters in charge of hospitalization and evacuation knew the number of patients who could be received by any single hospital in the course of a day and also knew to which hospitals to divert casualties when the first hospital had reached its limit.

When serious backlogs developed, it was sometimes found wiser to transport a casualty who would not be harmed by further evacuation to another hospital in which the workload was lighter and he could receive immediate surgery. During the pursuit north of Rome, some casualties who would have been held in army hospitals under more static conditions were evacuated for surgery to base hospitals earlier than ordinarily desirable. This was another operational necessity which was regarded as expedient but not desirable.

The 400-bed evacuation hospital, reinforced by two or more surgical teams, proved capable of handling the same number of casualties per day as a 750-bed evacuation hospital with its intrinsic staff. The larger capacity of the 750-bed evacuation hospital was an advantage, but a hospital of this size was cumbersome to move. When a 400-bed hospital was provided with extra bed capacity in the form of adequately equipped clearing platoons, it proved to be far more efficient in a fluid tactical situation than the larger hospital. This arrangement had another desirable aspect—the clearing platoons which furnished the additional beds could be left as holding units when the parent evacuation hospitals moved forward. These hospitals frequently had patients who had had

thoracic or abdominal or other major surgery shortly before, and it was just as important to hold these patients in these units for the proper length of time after operation as it was to hold the seriously wounded in the field hospital platoons for a certain period of time after surgery.

The rapid movement of evacuation hospitals was quite important. During the advance north of Rome, for instance, in the summer of 1944, gains of 15 miles a day or more by the Fifth U.S. Army were not uncommon. On one occasion, the 11th Evacuation Hospital was 15 miles behind the frontline on one day and 30 miles behind it on the next day. The 8th Evacuation Hospital, one day in June 1944, was placed only 6 miles behind the frontline and, within a few hours, found its forward location fully justified by the speed of the advance.

In spite of careful triage at the clearing station, it was inevitable that, as the load on field hospitals increased, the number of seriously wounded casualties in evacuation hospitals also increased, the most forward hospitals naturally receiving the most seriously wounded (p. 381). At the beginning of the offensive which culminated in the breakthrough into the Po Valley in April 1945, one evacuation hospital received so many casualties with extensive and often multiple wounds that it could not care for more than 40 in a 24-hour period, although its surgeons were experienced and competent and were aided by three auxiliary surgical group teams. The rearmost of the evacuation hospitals supporting this offensive, on the other hand, although it was augmented by only one surgical team, cared for 140 less seriously wounded casualties over the same 24-hour period with no difficulty at all.

During 1944, several significant changes and improvements occurred in Fifth U.S. Army evacuation hospitals, as follows:

1. The standard of thoracic surgery in a number of hospitals was greatly improved by the attachment to them of experienced thoracic surgical teams for periods of from 1 to 3 months. During this time, sustained efforts were made to teach the intrinsic surgical staff refinements in the management of wounds of the chest. This was a matter of considerable importance, since all chest surgery, except in nontransportable casualties, was done in evacuation hospitals. In addition, casualties with thoracoabdominal wounds often reached evacuation hospitals from forward areas in which there were no intervening field hospitals. Surgeons in evacuation hospitals who had the responsibility for these patients were kept busy, and it was essential that they be competent.

2. Most neurosurgery was also done in evacuation hospitals, and several hospitals which had no neurosurgeons on their staffs were strengthened by the temporary attachment of neurosurgical teams, which were withdrawn when the special need had passed.

3. The same plan was also followed with maxillofacial teams.

4. All evacuation hospitals adopted the policy of holding casualties in shock or preoperative wards before surgery. The assignment of cases to in-

dividual surgical teams and the decision as to the optimum time for surgery were sometimes the responsibility of the chief of surgery or his representative and sometimes that of the medical officer in charge of the shock ward. Postoperative care was usually supervised by the operating surgeon.

5. No elective surgery was performed in evacuation hospitals during periods of sustained combat activity. In quiet periods between offensives, minor elective surgery, including delayed primary wound closure, was sometimes permitted if it seemed likely that the patient could be returned to duty from the evacuation hospital or from the convalescent hospital in the army area. No major elective surgery was ever permitted in an evacuation hospital.

6. It became established practice for the surgical staffs of most evacuation hospitals to meet once a week or oftener for the presentation and discussion of clinical material.

Auxiliary Surgical Groups

Major Snyder's first assignment, before he was formally appointed professional services officer to the Surgeon, II Corps, was to evaluate the work of the teams from the 2d Auxiliary Surgical Group which were working in a British hospital in Algiers. His first orders when he reported to II Corps headquarters in March 1943 for temporary duty were to evaluate the use of similar surgical teams in clearing stations. He therefore became acquainted promptly with the excellent work of which these teams were capable as well as with their potentialities for usefulness in a combat zone.

Assignment to field hospitals.—Surgical teams from auxiliary surgical groups were used in field hospitals for the first time in the Sicilian campaign. Before the invasion, Colonel Amspacher and Major Snyder spent considerable time with the professional staff of the 11th Field Hospital and with members of the teams of the 2d and 3d Auxiliary Surgical Groups which were to augment its organic staff. Much of this time was devoted to the discussion of functions of field hospital platoons which were to serve as forward surgical units. During the latter part of the Sicilian campaign, the 10th Field Hospital also came under II Corps control.

Originally, field hospitals had functioned as little more than station hospitals. During the Sicilian campaign, when platoons from the 10th Field Hospital had been sent forward to install themselves beside clearing stations and provide surgical care for nontransportable casualties, it had become evident that, for this type of organization to function efficiently, its organic personnel must be augmented by teams from an auxiliary surgical group. Such teams were therefore attached to the 10th Field Hospital, just as they had been attached to the 11th Field Hospital before the invasion. This plan was used thereafter.

The professional personnel of auxiliary surgical group teams sent to field hospital platoons had to be selected with special care. Young, healthy general surgeons, capable of performing major surgery of the abdomen, chest, and extremities, proved most desirable. The specialist who was not also a good

general surgeon did not belong in a field hospital. Chest and abdominal wounds formed the major portion of the workload. The team on duty at any given time, however, had to be able to handle all the patients admitted while it was on duty; otherwise, extra loads had to be carried by other teams. This meant that such specialty teams as orthopedic surgery teams, neurosurgical teams, and maxillofacial teams were not ideally suited for work in field hospitals and were better attached to evacuation hospitals, in which these special wounds were chiefly handled.

Thoracic surgery teams capable of doing good general surgery were extremely valuable in field hospitals, though there were not enough of them to handle all the thoracic surgery which had to be done in them. The problem was best solved by attaching one thoracic surgeon to a field hospital platoon to perform some operations himself, to supervise preoperative and postoperative care, and to teach general surgeons the indications for, and the finer techniques of, thoracic surgical procedures. Many young general surgeons thus learned to do good thoracic surgery of the sort necessary in a field hospital.

Anesthesiologists with surgical teams also improved the efficiency of less well trained anesthesiologists in field hospitals by teaching them the technique of endotracheal anesthesia, the use of the bronchoscope for aspiration of the trachea and larger bronchi, and other techniques. In this connection, surgeons with experience in thoracic surgery did much to elevate the standards of anesthesia for this kind of surgery in both field and evacuation hospitals.

Assignment to evacuation hospitals.—Auxiliary surgical group teams also functioned in evacuation hospitals. As already mentioned, a 400-bed evacuation hospital, if augmented by two or three surgical teams, could do essentially the same volume of surgery as a 750-bed hospital with its organic personnel. In times of great activity, as many as six surgical teams were often assigned to an evacuation hospital.

Administrative considerations.—Originally, the auxiliary surgical group teams were not used to their full capacity. The teams which were attached to field and evacuation hospitals had to stay with these hospitals, even after their usefulness was ended. The II Corps surgeon in Africa and Sicily and the Fifth U.S. Army surgeon in Italy moved them only when they were needed elsewhere.

When the group headquarters was established in Italy in 1944, close coordination was effected between the Office of the Surgeon, Fifth U.S. Army, and the group headquarters, under the command of Col. James H. Forsee, MC. For example, when a team had finished work at a field or evacuation hospital, it was recalled to group headquarters, to rest up and get ready for the next job.

All teams had to be kept on the alert, to be prepared to move on very short notice to field hospital platoons which were receiving more casualties than the teams already assigned to them could handle. The fact that it was possible to shift teams rapidly to the units in which they were needed did much to improve the caliber of surgery in the Fifth U.S. Army. In fact, the Sicilian experience

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proved that the attachment of surgical and other teams from auxiliary surgical groups to field hospitals provided far better surgical care than had been provided earlier, when surgery was done in clearing stations. On 12 May 1944, for instance, Major Snyder found a backlog of surgical cases at the 11th Field Hospital, which was supporting the 85th Division in the breaching of the Gustav Line. Colonel Forsee was notified, and additional surgical teams were at once sent forward to supplement the three teams already assigned to the hospital. Three days later, the 56th Evacuation Hospital also had a large backlog of operations. Several complete surgical teams were immediately sent forward to help it. Rapid movement of this kind would have been impossible without the proper administrative setup.

The number of teams attached to a field hospital had to be flexible, first, to compensate for the increase in surgery which resulted from a broadening of the concept of the nontransportable casualty, and, second, to meet the increased workload in peak periods. Two teams could readily handle all the work during static periods, but at least six surgical teams and two shock teams were required during an offensive, while the use of eight surgical teams was not at all unusual.

When the mission of field hospitals was extended to the surgical care of nontransportable casualties, it was found, as already noted, that the organic staff was not sufficient to handle the new responsibilities. Late in 1943, as a partial solution of this problem, it became the practice to appoint the chief surgeon of some one of the auxiliary surgical group teams attached to the field hospital as chief of the surgical service in it. The appointment was made by the commanding officer of the field hospital, with the advice of Colonel Forsee and Major Snyder.

This plan did not prove particularly satisfactory. One reason was that, occasionally, early in the war, the ranking officer was not the officer best qualified professionally to serve as chief of the surgical service. Another reason was that the professional work of this officer with his own team left him little time to supervise the whole surgical service adequately.

These difficulties were gradually overcome. In December 1943, Major Snyder was given permission by Lt. Col. (later Col.) Clement F. St. John, MC, Chief of Plans and Operations, Office of the Surgeon, Fifth U.S. Army, to confer with Colonel Forsee about the placement of auxiliary surgical group teams in field hospitals and the use of one of the surgeons as chief of surgery. Additional discussions were held with Lt. Col. Samuel A. Hanser, MC, Commanding Officer, 33d Field Hospital, and with Maj. James M. Mason III, MC.

At this time, there was considerable feeling between field hospital personnel and auxiliary surgical group personnel; field hospital personnel, rather naturally, resented the alterations in their functions required by the addition of surgeons to take care of surgery which they had been led to believe they would perform themselves. Major Hanser took a broadminded and highly intelligent view of the new arrangements and was most cooperative and under-

standing. Major Mason was a competent surgeon, who understood the professional and administrative problems of forward surgery and could advise Major Snyder concerning the new problems likely to arise with the appointment in a field hospital of a surgical chief who was not part of its organic personnel.[17]

The problem was eventually solved by the appointment of the most experienced officer among the teams assigned to a field hospital platoon to perform the duties of surgical chief for the platoon. It was soon found that the most practical plan was to relieve this officer of all duties on his own team, so that he could devote himself entirely to the supervision of the work in the hospital. His duties included triage; supervision of preoperative preparation, resuscitation, and postoperative care; and consultation, as necessary, on wounds of particular severity or difficulty. His work in the operating room was limited to assistance in cases of this kind and to the demonstration of new techniques and of modifications of established techniques to the hospital staff.

Not the least important of the functions of the chief of surgery was cooperation with the commanding officer of the hospital in the correlation of administrative and professional functions. In the last 6 months of the war, the chief of surgery in a field hospital came to be known, very properly, as the coordinator. The title was first employed in the 2d Platoon of the 33d Field Hospital, in which Lt. Col. Sigurd C. Sandzen, MC, of the 94th Evacuation Hospital, was serving as chief of surgery. Colonel Sandzen had requested this assignment.

A similar request was made by Col. Eldridge H. Campbell, Jr., MC, of the 33d General Hospital, who served as surgical coordinator at the 1st Platoon of the 33d Field Hospital during the Po Valley offensive, in April 1945. Colonel Campbell, earlier, had brought a complete team of anesthesiologist, nurses, and enlisted men to serve with him for several weeks in a field hospital.

During the spring of 1944, it was proposed that a forward surgical unit be made up from the staff of the 38th Evacuation Hospital (fig. 72), to handle first priority cases. The tables of organization and equipment for this unit were prepared, but the hospital found itself with so much to do that the proposal was dropped.

LIAISON WITH MEDICAL UNITS OF OTHER ALLIED ARMIES

Part of Major Snyder's duties as consultant in surgery to the Surgeon, Fifth U.S. Army, included liaison with, and assistance to, Allied medical units

[17] Both General Martin and his executive officer, Col. Charles O. Bruce, MC, thought that the difficulties which had arisen in the operation of field hospitals in the Mediterranean theater might be eliminated by the formation of a mobile army surgical hospital in which the commanding officer, a competent general surgeon, would serve as chief of surgery. This unit would have the proper number of qualified surgeons as part of its integral personnel, or its personnel could be supplemented, as necessary, by teams from an auxiliary surgical group. The tables of organization and equipment for such a unit were drawn up in the Office of the Surgeon, Army Ground Forces, to which Colonel Bruce was assigned after the war. It was a disappointment to Colonel Snyder that mobile army surgical hospitals were not used in Korea as field hospital platoons augmented by surgical teams had been used in Italy.

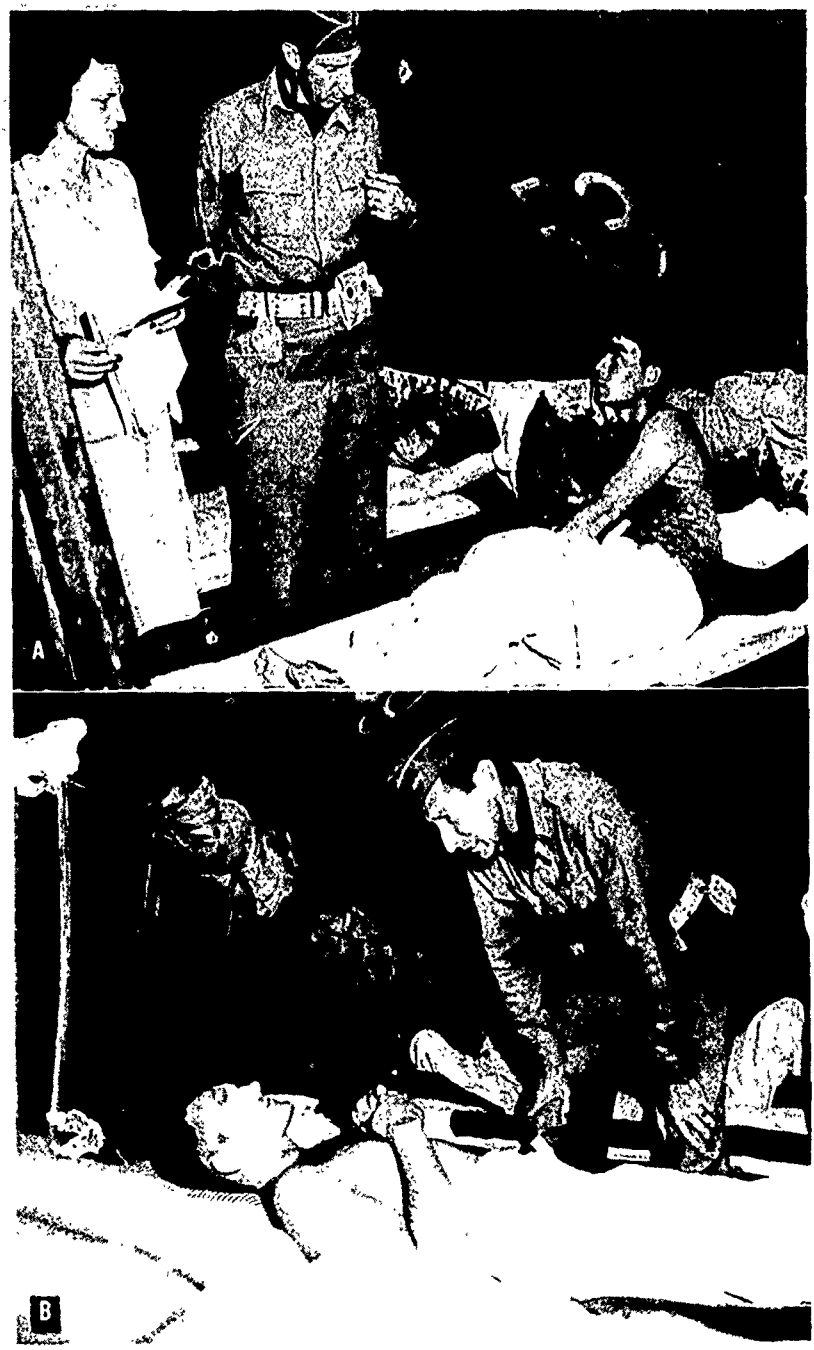


FIGURE 72. Lt Gen Mark W. Clark, Commanding General, Fifth U. S. Army, visiting 38th Evacuation Hospital near Leghorn, August 1944. A. Visiting Pvt. Naka Masato, an American of Japanese descent, who was awarded the Oak Leaf Cluster. B. Visiting Pfc. Steven Auer.

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serving with the U.S. Army. The following activities are typical of this phase of his duties:

On 26 November 1943, he visited a French field hospital near Monte Cassino. The unit was supposed to have three surgical teams, each working an 8-hour shift, and an attached mobile surgical unit. Each team, which consisted of a surgeon, an anesthesiologist, 2 nurses, and 2 corpsmen, was expected to handle 16 surgical cases in each 8-hour operating period. Since only two teams were presently attached to the unit, the staff was working 12-hour shifts. Two operating tables were in continuous use. The third table was supplied with fluoroscopic facilities. Tentage was limited, and sterilizers were in short supply, but otherwise the teams had all the equipment they needed. The surgical work at this hospital was excellent.

On 9 January 1944, U.S. station and general hospitals at the Fair Grounds at Naples, which were receiving French wounded, were visited, to determine whether the complaint that surgery performed in French forward hospitals was too radical was justified. No instance of overzealous debridement was found in the patients examined, all of whom seemed in excellent condition.

On 4 February 1944, Major Snyder, accompanied by Maj. Oscar P. Hampton, Jr., MC, then serving as acting consultant in orthopedic surgery for the theater, visited the 401st Evacuation Hospital (French), then located between Alife and Pratella. They came away with only admiration for the work being done. A suggestion made by Maj. Etienne Curtillet was promptly adopted in U.S. Army hospitals; namely, that plain fine-mesh gauze rather than petrolatum-impregnated gauze be used in wounds. Major Hampton was particularly impressed by this suggestion and did much to disseminate it.

When a Brazilian Expeditionary Force joined the Fifth U.S. Army in the summer of 1944, U.S. Army medical officers were designated to supervise their training in first aid measures and field sanitation. Professional Brazilian personnel were at first assigned to the 38th Evacuation Hospital, which was supporting U.S. troops holding down the left flank of the Fifth U.S. Army sector; Brazilian troops had been integrated with these troops. When the 16th Evacuation Hospital moved to Pistoia in November 1944, Brazilian medical personnel were attached to it, and it was designated to care for Brazilian casualties. Lt. Col. Manuel E. Lichtenstein, MC, chief of surgery at this hospital, organized the Brazilian personnel into teams, with definite assignments, and they rapidly became an excellent working organization.

Brazilian casualties who required evacuation from the Fifth U.S. Army area were sent to the 7th Station Hospital, which was then serving as a general hospital in Leghorn, and those who required evacuation from the theater were sent to the 45th General Hospital in Naples.

On 5 December 1944, Major Snyder visited a platoon of the 32d Field Hospital beyond Pistoia, in which a Brazilian surgical team was working. The team was headed by the professor of surgery at the University of São Paulo, a well-qualified surgeon, whose team was doing excellent work.

EQUIPMENT

Early Deficiencies

When the 77th Evacuation Hospital arrived in England, the only equipment which it had for thoracic surgery was a pair of rib shears, a right and left rib raspatory, and a No. 14 French ascites trocar. Other general and special surgical equipment was also lacking. The explanation of some of these deficiencies came to light in North Africa, when it was discovered, from the 1918 newspapers in which the instruments were packed, that the table of equipment by which they had been provided was a World War I table.

Observations in British chest centers (p. 333) showed that the British were well equipped for thoracic surgery at this time. Their sets had been standardized, and more than 50 had been distributed to Army, Navy, and Air Force units. They included long-handled instruments for working within the thorax; endoscopic equipment; adequate anesthesia apparatus; and various anesthetic agents for chest surgery, including cyclopropane. The equipment also included tables or cabinets equipped to convert electrical current into high frequency current for cutting and coagulation, as well as for converting the current into low tension current for use with endoscopic and other lighted instruments. This type of table also had a suction machine attached. It thus took the place of (1) the Bovie apparatus used for cutting and coagulation, (2) the suction machine, and (3) the battery case or rheostat which provided low tension current for lighted instruments. The British regarded this particular piece of equipment as indispensable for chest surgery. Mobile thoracic surgery teams functioning in the United Kingdom were also supplied with all the equipment just listed, as well as with portable X-ray apparatus.

The proper steps were at once taken to report the inadequacy of the 77th Evacuation Hospital equipment. Meantime, the medical officers on the staff each donated a small amount of money, which proved sufficient for the purchase of a suction machine and a Bovie electrosurgical unit for neurosurgery. Members of the thoracic surgery team personally purchased a bronchoscope and a number of instruments for thoracic surgery. The equipment was secured at the Genito-Urinary Manufacturing Company Limited in London, an old and well-established firm which had originally supplied only cystoscopes and other instruments for genitourinary surgery but which now handled equally excellent surgical equipment of all kinds.

Even with the equipment supplied personally by members of the thoracic surgery team in the 77th Evacuation Hospital, its equipment, like that of other U.S. evacuation hospitals, did not begin to equal the British equipment for even their mobile surgical units. When the 77th Evacuation Hospital was assigned to the II Corps, Colonel Arnest and Major Amspacher did all in their power to bring the equipment up to standard requirements, but in the 10 days before the unit sailed for North Africa this was an impossible task. The deficiencies were

unfortunate, for competent thoracic surgery is impossible without proper equipment.

When the 77th Evacuation Hospital reached Oran and had to assume the care of casualties immediately (p. 335), it found some of the equipment of the 38th Evacuation Hospital, which had landed at Arzew a little earlier, at the hospitals it was taking over. This was fortunate, for the 77th Evacuation Hospital did not receive any of its own limited equipment until several days after it had landed. The situation of this hospital in respect to deficiencies of equipment and delayed receipt of such equipment as had been provided was unfortunately characteristic of the situation of many other hospitals during the early fighting in North Africa.

Recommendations.—When Major Snyder was placed on temporary duty in II Corps headquarters in March 1943 to evaluate the use of surgical teams in clearing stations (p. 336), he made a number of recommendations to the Surgeon, II Corps, concerning the equipment of these teams, as follows:

1. Portable anesthetic equipment is essential for the care of patients with certain types of wounds and must be provided if surgery is to be provided in clearing stations.

2. A larger autoclave for sterilizing linens and dressings is a basic need, as is a field range burner unit for heating the sterilizer.

3. A satisfactory portable operating table is also a basic need in each clearing station.

4. A pelvic rest or a portable Hawley fracture table must be available for all general surgery teams as well as for all orthopedic surgery teams of auxiliary surgical groups.

5. A portable suction machine would be of great value in the surgery of perforating wounds of the abdomen.

6. Teams of auxiliary surgical groups should have their own transportation.

These recommendations were all eventually carried out, though the question of transportation for teams from the auxiliary surgical groups was never entirely settled. In southern Tunisia, teams attached to the II Corps were provided with their own transportation by Colonel Arnest. When they returned to their headquarters, this transportation was turned in. The arrangements in Sicily were similar. After the headquarters of the 2d Auxiliary Surgical Group was moved to Italy, the group was authorized a certain amount of transportation, and Colonel Forsee maintained it in a motor pool, sending it forward as necessary when the teams had to be moved.

Sicily

Before the invasion of Sicily, the field hospitals, which replaced clearing stations of medical battalions as the most forward installations in which surgery was to be performed, were provided with much more in the way of surgical equipment than the clearing platoons had possessed. There were, however, still a number of shortages.

One of the most conspicuous shortages was in anesthetic apparatus. In Sicily, evacuation hospitals had anesthetic machines, though the number was somewhat limited. Auxiliary surgical group teams working in field hospital platoons were still ill-equipped in this respect. Maj. (later Lt. Col.) Lawrence M. Shefts, MC, did most of his intrathoracic work, as a matter of necessity, under Pentothal sodium and oxygen, the oxygen being supplied through a BLB (Boothby, Lovelace, Bulbulian) mask. His results were extremely satisfactory. In fact, he performed so many operations with this sort of anesthesia without untoward consequences that he almost convinced himself and his associates that this was the ideal anesthesia for intrathoracic work, in which it is generally regarded as contraindicated.

In Sicily, field hospitals had only a single X-ray machine for each hospital. It was promptly evident that if a field hospital's three platoons were to function satisfactorily as individual platoons, each must have its own X-ray equipment. X-ray equipment was also necessary in all holding units if adequate postoperative care was to be supplied.

In 1943, when X-ray films were in short supply, limitations had to be placed upon the number used. In 1944, when supplies became more abundant, these limitations were removed. Then, almost without exception, roentgenograms were made before operation unless the surgeon was absolutely certain that there were no fractures and no retained foreign bodies. Some hospitals improvised large dryers, so that the dry processed films were ready when the patients went to the operating room.

Transportation difficulties explained some shortages of equipment in Sicily. In one collecting station, for instance, three patients with compound fractures of the femur were brought in by litter between 12 and 18 hours after wounding, all of them unsplinted because the battalion surgeon, who was receiving his supplies by pack mule, had run out of splints and his fresh supplies had not arrived. It is a tribute to the atraumatic fashion in which these patients had been handled that none of them was in shock.

Italy

After the first 6 months of the campaign in Italy, except for such special circumstances as have just been described, surgeons in the Fifth U.S. Army usually had the best equipment available for field surgery and had it in ample amounts. Some annoying and wasteful shortages, however, still persisted. A small electrical unit, equipped to resharpen operating knife blades, for instance, would have relieved the frequent shortages of these blades and would have prevented the discarding of instruments which otherwise might have been used for many more months.

Some equipment, such as audiometers, was always in limited supply, and patients who required a study of possible hearing loss were sent to the special centers which possessed them. This was not an unreasonable arrangement. Similarly, casualties who required electrocardiograms had to be evacuated to

the base until the 8th Evacuation Hospital was established as the army center for all such investigations.

Transportation of supplies was a considerable problem in Italy in April 1945, during the race across the Po Valley, when supply depots and dumps were still back in Florence. Medical supplies then often had to give way to more crucial needs, such as gasoline, ammunition, bridging materials, and rations.

Nonstandard Equipment

One of the duties of the surgical consultant to the Surgeon, Fifth U.S. Army, was to advise him and his medical supply officer concerning the surgical equipment needed for all army medical installations. In line with this duty, requests for items in excess of tables of equipment were submitted to Major Snyder for comment and advice. His advice was always followed. Some of the additional equipment was really needed, but a great deal was not. It often took newly inducted officers some time to learn that they were not operating under conditions of civilian life and must make do with what they were given. As a matter of fact, a directive from the threater commander permitted the army surgeon to make additions to the equipment lists of hospitals in the area as he considered it necessary. This permission was a great aid to efficient functioning when demands on a hospital were abnormally high or when special equipment was really needed.

Anzio

Supplies at Anzio furnished a number of critical problems, though the original landings were without incident. The first section of the Advance Platoon, 12th Medical Depot Company, arrived with the second wave of assault troops on D-day. After the first landings, however, no other medical supplies could be landed for the next 5 days. Fortunately, enough had been brought ashore to cover this period. So many supplies were destroyed by shelling when they were concentrated in the usual dumps that it was necessary to distribute them widely, in order to protect them.

Acute shortages of blankets, litters, and similar items developed because, when patients were loaded on LST's for evacuation to Naples, there was no time, and it was not the place, for exchanges and bookkeeping. Eventually, a plan was set up of placing an empty ¾-ton truck on every boat which took casualties to Naples. When the ship arrived at the base, the truck was loaded with litters and blankets which were provided by the hospitals receiving the patients. The truck was returned to the beachhead on the LST.

Improvisations

The development of improvised equipment to overcome shortages and of special devices to improve techniques was heartily encouraged in all hospitals, and information concerning these items was promptly disseminated. The improvisations ranged from the simple bending of the rod in an ammunition box

to fit it for use as a plasma stand to the construction of a refrigerator for the storage of whole blood.

The 47th Armored Medical Battalion, when a shadowless light for the operating room was required, constructed one by reclaiming the headlights of several vehicles destroyed by enemy action and inserting the frosted, cross-ribbed glass in front of a light bulb. When the light was attached to a swinging arm, it could be focused on the wound without casting a shadow. When medical officers of the same unit were called upon to explore eardrums without an otoscope, a very efficient one was constructed from a flashlight, an aluminum cone salvaged from a crashed enemy aircraft, and a magnifying glass.

At the 38th Evacuation Hospital, an excellent vacuum bottle was devised from an old Baxter saline bottle. A tire patch was used to cover the two holes in the rubber stopper. A small amount of citrate solution was then placed in the bottle, which was autoclaved with the rubber stopper inserted loosely. As soon as the autoclave was opened, the stopper was jammed into the neck of the bottle. Enough suction could be developed with this improvised vacuum bottle to withdraw a liter of blood. The same bottles were used in donor sets as well as for aspiration of the chest. They worked very well for all of these purposes. One improvisation, the use of Baxter bottles in which saline solution had been put up to collect urine, proved of great clinical usefulness. It was essential that accurate urinary output records be kept on all patients in field hospitals, but there was very little time and very limited personnel for this purpose. The problem solved itself when a Baxter bottle was kept by the cot of every patient in a field hospital unit and the contents were measured each time (usually twice daily) the bottle was emptied. This proved a very practical method of recognizing oliguria and impending anuria.

Suction for intra-abdominal surgery was provided by an ingenious plan in the clearing station at Gafsa and in the 48th Surgical Hospital at Fériana. A jeep or command car was moved close to the operating tent, and a long rubber tube was connected to the suction apparatus which ran the windshield wiper of the car. The tubing was brought into the tent and connected to a suction bottle, after which the windshield wiper was turned on. This meant the sacrifice of a needed vehicle, but commanding officers were more than willing to give up a car to provide this very essential aid to abdominal surgery.

The Relation of Equipment to Results

After the Peninsular Base Section was established, all Fifth U.S. Army medical supplies were secured from it, as were supplies for the French and Brazilian units, and sometimes for the Italian and British units, which served with this army. During the Italian fighting, 2,524 tons of medical supplies were received by the 12th Medical Depot in the Peninsular Base Section, and 2,402 tons were issued.

Surgery in the Fifth U.S. Army showed steady improvement and increasingly good results after the landings in Salerno. While there is no doubt that

part of the considerably less good results originally secured can be explained by inexperience of surgeons untrained in military surgery, equipment shortages also had something to do with them. Later, when experience had been accumulated and supply shortages had ceased, the surgical results in the Mediterranean threater were outstanding, and a continuous flow of highly efficient equipment undoubtedly played some part in them.

REASSIGNMENT OF MEDICAL UNITS FOR OPERATION ANVIL

In July 1944, in preparation for the invasion of southern France (Operation ANVIL) by the Seventh U.S. Army on 15 August 1944, the following medical support was withdrawn from the Fifth U.S. Army:

1. The 52d and 56th Medical Battalions.
2. The 10th and 11th Field Hospitals.
3. The 11th, 93d, and 95th Evacuation Hospitals, each of which had a capacity of 400 beds.
4. Half the teams of the 2d Auxiliary Surgical Group.

The surgical burden thus thrown upon the remaining medical support of the Fifth U.S. Army, while enormous, was not felt immediately because the fighting had slowed down considerably when these units were withdrawn. When, however, the character of combat changed from the battle of pursuit which had occurred during July and August to the bitter fighting during the North Apennines campaign in the fall and winter of 1944–45, the changed tactical situation produced the heaviest sustained combat load in the history of the Fifth U.S. Army.

The medical service of the Army was called upon to handle this load with seriously impoverished resources; at first only one new unit (the 15th Field Hospital) was assigned to it to replace the two field hospitals and the three evacuation hospitals which had been withdrawn to support the Seventh U.S. Army. Medical personnel worked at top speed to try to keep abreast of the constant flow of admissions, but there was a limit to the physical endurance of the surgeons, and it was necessary to acquire surgical teams from base hospitals to augment their depleted numbers.

The use of these teams, for a number of reasons, was not the solution of the problem, and the difficulties of the medical service were brought to the attention of the Commanding General, Fifth U.S. Army, in a letter from the Surgeon, Fifth U.S. Army, and were in turn brought by him to the attention of the Commanding General, NATOUSA, on 15 December 1944, as follows:

> Based on the assumption that Fifth Army would consist only of one U.S. Corps (with not more than three divisions actively engaged) with a very narrow front, an unusually large number of Fifth Army service units were assigned to Seventh Army to support adequately French and U.S. Operations. Since 15 July 1944, the 92nd Infantry Division, a Brazilian Infantry Division, the * * * Infantry Regiment and the * * * Tank Battalion have been added to the Fifth Army troop list without addition of any service units other than those being activated. * * * Not only has there been an increase of combat troops,

but Fifth Army has been required to commit two corps on a wide front * * * with the result that a very critical shortage of service units has developed and is severely handicapping the Fifth Army operations at one of the most critical times of the Italian Campaign. Fifth Army now has seven Evacuation Hospitals to support six U.S. divisions, one Brazilian Division and one separate infantry regiment * * *. One complete surgical group is necessary to provide adequate surgery for Fifth Army * * *. Fifth Army has operated several months with an insufficient number of surgical teams and it has been necessary to provide teams from Evacuation Hospitals for Field Hospitals in forward areas and this has seriously reduced the surgical service of the Evacuation Hospitals * * *. A few teams have been provided from base units at various times * * *. If it was necessary to attach these teams during the time Fifth Army was regrouping, additional teams will be necessary when active operations begin * * *. Duration of attachment of Base Section Hospital teams to Evacuation Hospitals has been limited and the teams are often recalled during the time when their need is critical. The solution most desirable to Fifth Army is the return to Fifth Army of that part of the Second Auxiliary Surgical Group which was assigned to Seventh Army * * *.

"The solution most desirable to Fifth Army" did not come to pass, and the medical service problems were resolved as follows:

1. The 29th Station Hospital was converted to the 170th Evacuation Hospital. The responsibility for its conversion, the training of unit personnel, and the assembling of appropriate equipment for the operation of an evacuation hospital was assigned to the Surgeon, Fifth U.S. Army.

2. At the same time, the 15th Field Hospital was assigned to the Fifth U.S. Army. The headquarters and two platoons were withdrawn from Corsica and the remaining platoon was withdrawn from Seventh U.S. Army control in southern France.

Medical service in the Fifth U.S. Army was not further augmented through the remainder of the war in Italy.

RECORDS, SPECIAL REPORTS, AND PUBLICATIONS

Records.—In all tours of hospitals, Major Snyder made it a practice to discuss clinical records, examine them at random, and insist that they be kept complete and up to date. He made detailed notes of special cases in his official diary, especially those from which lessons could be learned concerning good management as well as poor management and frank errors. These case histories, as already noted, proved very useful in the educational program.

Essential Technical Medical Data reports were carefully read before they were transmitted to the Surgeon, Fifth U.S. Army. Major Snyder added such comments as seemed indicated, but the reports were neither condensed nor edited. He also submitted with them any material of value which he had collected himself.

Full records were always kept by the teams of the 2d Auxiliary Surgical Group, first by the members themselves. In the course of the fighting in southern Tunisia, Major Amspacher directed that the teams send copies of their clinical records on all II Corps casualties to the corps surgeon's office. Colonel Forsee continued this policy, and during 1944 and 1945 team records of surgical

cases were kept on special forms and in duplicate. The analysis of the material for 1944 and 1945 represents the most complete and most careful study of a series of combat-incurred abdominal injuries ever to be recorded. It forms the major portion of one of the surgical volumes of the history of the U.S. Army Medical Department in World War II.[18]

Special reports.—A number of special surgical investigations were made in the Fifth U.S. Army and were formally reported to the army surgeon, as follows:

1. Shock, with special reference to hematocrit and plasma protein values, by Capt. Joseph J. Lalich, MC (p. 412).
2. Shock, by Maj. D. Stewart, MC (p. 413).
3. Transfusion therapy in battle casualties with evidences of circulatory failure, by Captain Lalich.
4. The surgery of abdominal wounds, by Maj. Fred J. Jarvis, MC.
5. Intrapleural and intrathoracic wounds, by Capt. (later Maj.) Leon M. Michels, MC.
6. Thoracoabdominal battle casualties, by Capt. Henry L. Hoffman, MC, and Capt. Aaron Himmelstein, MC.
7. Trenchfoot, by Maj. Fiorindo A. Simeone, MC (p. 428).
8. Arterial injuries, by Major Simeone (p. 431).
9. Gas gangrene, by Maj. Floyd H. Jergesen, MC, and Major Simeone (p. 445).
10. The physiology of the severely wounded, by a special board from the theater surgeon's office, which partly elucidated, but did not solve, the special problems of oliguria and anuria in wounded men. This report forms another of the volumes of the surgical series in the history of the U.S. Army Medical Department in World War II.[19]

Publications.—Major Snyder consistently encouraged individual medical officers who were accumulating a wide experience in war surgery and in the management of shock and other related conditions to keep their own detailed records and, later, when their data were sufficiently comprehensive, to prepare it for publication in scientific journals. He read all of the articles to be submitted for publication and returned them to the authors for necessary alterations before they were cleared for the journals of choice.

In all, some 50 articles were submitted for publication from the Fifth U.S. Army, covering a wide range of subjects, as follows: Administrative considerations, including the use of surgical teams from auxiliary surgical groups; shock and resuscitation, including the use of whole blood; anesthesia; gas gangrene; trenchfoot; chemotherapy and antibiotic (penicillin) therapy; causes of death in battle casualties; craniocerebral wounds; maxillofacial

[18] Medical Department, United States Army. Surgery in World War II. Volume II. General Surgery. Washington: U.S. Government Printing Office, 1956.

[19] Medical Department, United States Army. Surgery in World War II. The Physiologic Effects of Wounds Washington: U.S. Government Printing Office, 1952.

wounds; chest injuries, including contributions on wet lung, nerve block, decortication in empyema and hemothorax, and wounds of the heart; thoracoabdominal injuries; wounds of the abdomen, with special reference to wounds of the colon and rectum; urogenital wounds; and vascular surgery, including the use of the tourniquet.

STATISTICS

From the beginning of combat in North Africa in November 1942, much emphasis was placed upon the importance of performing post mortem examinations on all patients who died in army hospitals. Theoretically, this should have been a routine matter; the understanding was that autopsy would be performed in all such deaths. Actually, for a variety of reasons—not all of them based upon the pressure of work—autopsy was omitted in many cases.

This was the situation in the North African theater late in 1943 when Major Snyder initiated a special project concerned with the detailed analysis of deaths from combat-incurred wounds in Fifth U.S. Army hospitals.

On 31 December 1943, Colonel Martin, the army surgeon, sent a letter to all hospitals in the Fifth U.S. Army area directing that complete records of all deaths in these hospitals, including the autopsy protocols, be submitted to his office. Reports began to come in promptly, but some hospitals were negligent or careless about the details required, and on 22 April 1944 the attention of commanding officers of hospitals was called to Colonel Martin's original letter.

There was a progressive increase in the percentage of post mortem examinations reported as time passed (table 7), the proportion rising from less than a third of the deaths reported in the January–March 1944 period to more than 80 percent in the January–May 1945 period. There was also a corresponding rise in the number of histologic examinations in autopsied cases.

From the time the project was initiated, the analysis of these reports occupied the attention of the surgical consultant for at least part of his time several days a week. Each case history was carefully studied, and an unexpectedly large amount of information was secured from them. For one thing, it was possible to evaluate the results of various methods of treatment as well as the overall care the casualties were receiving in army hospitals. For another, the analysis proved extremely useful in the educational program which was still underway because inexperienced units were still coming into the theater. If errors were disclosed which needed correction, they were discussed immediately with the responsible personnel. This proved a rapid and practical way of instructing inexperienced surgeons in the principles and practices of military surgery.

The medical circular issued from the Office of the Surgeon, Headquarters, Fifth U.S. Army, on 7 April 1944,[20] is an illustration of the practical applica-

[20] See footnote 11, p. 361.

TABLE 7.—*Periodic analyses of post mortem studies in Fifth U.S. Army hospitals, 1 January 1944–2 May 1945* [1]

Period	Number of deaths studied	Gross autopsy reports		Histologic reports		
		Number	Percentage of deaths studied	Number	Percentage of deaths studied	Percentage of reported autopsies
1944						
January–March	529	171	32.3	37	7.0	21.6
April–July	482	254	52.7	119	24.7	46.9
August–December	284	180	63.4	99	34.9	55.0
1945						
January–May	155	128	82.6	94	60.6	73.4
Total	1,450	733	50.6	349	24.0	47.6

[1] During this period, 1,562 U.S. battle casualty deaths were reported from Fifth U.S. Army hospitals, but the histories of only 1,450 were received in time to be included in this analysis.

tion of these analyses. It was prepared by the surgical consultant as soon as certain errors in triage became evident in the survey of these post mortem reports. Paragraph four of this circular follows:

> 4. Intra-abdominal wounds have been overlooked particularly when the wound of entrance was not in the abdominal wall. Patients who have received plasma for shock at Battalion Aid Stations, Collecting Stations, Clearing Stations, or Field Hospitals, have been sent on to Evacuation Hospitals, when their blood pressure readings returned to normal. This group of patients is particularly prone to develop severe shock with further evacuation and should receive surgical care in the most forward Field Hospital unit. Failure to recognize first priority cases in other categories has been costly. Careful triage or sorting in the clearing station will save lives.

Analyses concerned with various periods of the Italian campaign showed a progressive improvement in the results of surgery on combat casualties. It was thought that this study, which was based upon insistence on good clinical records, played no small part in the continued improvement in results in army hospitals and in the high level of achievement finally attained.

In March 1945, Capt. (later Maj.) James W. Culbertson, MC, 8th Evacuation Hospital, was placed on temporary duty in the office of the army surgeon to work with Colonel Snyder in the preparation of a formal report on these studies.[21] Captain Culbertson devoted his entire time to this project until it was completed early in September 1945.

[21] Snyder, Howard E., and Culbertson, James W.: Study of Fifth U.S. Army Hospital Battle Casualty Deaths. *In* Medical Department, United States Army. Wound Ballistics. Washington: U.S. Government Printing Office, 1962, pp. 473–530.

Analysis of Hospital Deaths

Between 1 January 1944 and 2 May 1945, the date of the German surrender in Italy, 1,562 deaths from battle-incurred injuries in Fifth U.S. Army hospitals in Italy were reported to Major Snyder. Sufficiently detailed records on 1,450 of these reached him in time to be included in his analysis. When these records were examined in detail, it was found that 39 of the cases included in them did not entirely fit the terms of reference of the study, as these patients were dead on arrival. The number of the complete analyses, therefore, was necessarily limited to 1,411 cases.

The data analyzed by Colonel Snyder and Captain Culbertson (tables 8 through 13) included the distribution of wounds and deaths by periods according to the anatomic location of the injury, the wounding agent, and the place of death (field or evacuation hospital); and the principal causes of death. The tables reproduced herewith represent only a small proportion of the enormous amount of data secured in the analysis.

It is difficult to make precise statements about battle casualty deaths because of the large number of variables concerned, some of which are beyond control. Misleading conclusions, furthermore, are readily arrived at unless statistics are interpreted in the light of circumstances.

It is generally agreed that, in all wars, the proportion of casualties who die on the battlefield of their wounds is about 20 percent, or one in every five. This was true in Italy, in which the percentage for the January 1944–May 1945 period was 19.86. The proportion was highest (20.7 percent) in the January–March 1944 period and lowest (18.84 percent) in the August–December 1944 period.

A valid method of analyzing the efficiency of a medical service is on the basis of the number of wounded who reach hospitals alive. Hospital case fatality rates, however, are dependent not only upon the efficiency of the

TABLE 8.—*Percentage distribution of wounds and deaths according to anatomic location of injury in 71,000 casualties admitted to Fifth U.S. Army hospitals, 9 September 1943–31 May 1945*

Location of wound	Wounds (percentage)	Deaths (percentage)
Head	6.75	19.90
Maxillofacial	6.11	1.61
Chest	8.92	21.80
Abdomen	4.11	28.70
Lower extremity	39.20	16.17
Upper extremity	26.20	5.08
Other	8.71	6.74
Total	100.00	100.00

TABLE 9.—*Percentage distribution of wounding agents, and deaths therefrom, in 71,000 casualties admitted to U.S. Army hospitals, 9 September 1943–31 May 1945* [1]

Wounding agent	Wounds (percentage)	Deaths (percentage)
Bullets:		
Rifle	5.28	4.27
Machinegun	3.68	3.77
Unclassified	8.27	8.94
Total bullets	17.23	16.98
High explosives:		
Shell	64.50	66.34
Mine	5.88	5.67
Blast	3.15	.11
Bomb	2.64	3.90
Boobytrap	.39	----
Hand grenade	.26	----
Unclassified	5.95	7.00
Total high explosives	82.77	83.02
Grand Total	100.00	100.00

[1] Including 2,398 self-inflicted wounds.

medical service that the hospital provides but also upon the efficiency of the evacuation service which brings casualties to it. At Anzio, where hospitals were located very close to the frontline, casualties reached the hospitals rapidly, and the hospital case rate was as high as 5.7 percent. At other times and in other areas, when hospitals were further removed from the front, hospital case fatality rates were much lower. Generally speaking, however, the overall mortality is improved by rapid evacuation, which brings the patient to surgery more promptly.

In Italy, between January 1944 and May 1945, inclusive, a number of surveys produced the following data:

1. In the January–March 1944 period, 35.3 percent of all casualties who died in army hospitals died before the induction of anesthesia. The percentage fell during successive surveys and reached 21.6 percent during the January–May 1945 period.

2. In the January–March 1944 period, 7.3 percent of all battle casualties who were killed in action or died of wounds died in hospitals after the induction of anesthesia. The percentage also fell during successive surveys and reached 5.3 percent during the January–March 1945 period.

3. In the January–March 1944 period, 1.515 percent of all battle casualties (including those killed in action and those injured or wounded in action) died in hospitals after the induction of anesthesia. The percentage also fell

TABLE 10.—*Comparative frequency of wounds according to anatomic location of injury in 22,246 casualties admitted to Fifth U.S. Army hospitals, 1 August 1944–31 May 1945*

Location and type of wound	Rate per thousand		
	Evacuation hospital	Field hospital	Total
Head:			
Intracranial	8.70	20.50	19.50
Scalp	8.80	41.00	37.75
Maxillofacial:			
Bone	6.50	12.00	12.20
Soft tissue	15.80	53.80	46.80
Eye and ear	4.30	21.80	20.00
Neck	18.30	21.00	20.70
Spine	.50	10.20	9.40
Chest:			
Superficial	27.20	38.18	37.30
Intrathoracic	210.00	31.55	46.40
Abdominal:			
Superficial	13.10	6.93	7.40
Intra-abdominal	185.00	14.30	28.40
Thoracoabdominal [1]	97.00	3.23	11.00
Combined [1]	31.00	3.24	5.58
Upper extremity:			
Superficial	18.50	67.00	62.00
Deep muscle	32.60	139.30	131.00
Compound fracture	32.60	57.00	54.00
Traumatic amputation	8.80	8.44	8.50
Lower extremity:			
Superficial	15.80	94.00	87.80
Deep muscle	85.00	251.00	237.00
Compound fracture	57.00	74.00	72.50
Traumatic amputation	107.00	13.30	21.00
Others	19.10	25.00	23.00

[1] Reporting of these two categories was considered inaccurate. Possibly some thoracoabdominal injuries were reported under combined intra-abdominal and intrathoracic injuries.

during successive surveys and reached 1.05 percent in the January–March 1945 period.

Other Data

Certain other statistical data might also be listed, as follows:

1. During 1944, 17 percent of all casualties in the Fifth U.S. Army were killed in action, and 72 percent were wounded in action. The remainder were missing in action or were taken prisoner.

2. Of the 72 percent wounded in action, 2.5 percent were returned to duty from division clearing stations after treatment, and 9 percent were given surgical care in field hospitals. The remainder received initial wound surgery at evacuation hospitals.

TABLE 11.—*Comparative case fatality rates according to anatomic location of injury in 22,246 casualties admitted to Fifth U.S. Army hospitals, 1 August 1944–31 May 1945*

Location and type of wound	Case fatality rate [1]		
	Field hospital	Evacuation hospital	Total
Head:			
Intracranial	20.69	30.05	27.19
Scalp			
Maxillofacial:			
Bone		1.55	1.50
Soft tissue	3.50	.19	.29
Eye and ear			
Neck	8.80	.23	.87
Spine	29.00	6.20	7.10
Chest:			
Superficial		.13	.24
Intrathoracic	11.00	5.74	7.80
Abdominal:			
Superficial			
Intra-abdominal	22.80	17.10	20.00
Thoracoabdominal	26.00	13.60	22.60
Combined	24.60	8.96	16.10
Upper extremity:			
Superficial			
Deep muscle		.03	.03
Compound fracture	1.68	.08	.16
Traumatic amputation	5.90	.58	1.05
Lower extremity:			
Superficial			
Deep muscle	1.90	.29	.34
Compound fracture	3.90	.80	1.00
Traumatic amputation	6.10	2.97	4.30
Others	9.50	.19	.55
Total	11.80	1.35	2.20

[1] Based on principal wound.

3. Of the wounded in action who reached medical installations, 2.9 percent died of wounds. Of these, 7 percent died in division clearing stations, 33 percent in field hospitals, and the remainder in evacuation hospitals.

4. The case fatality rate in wounded casualties who received emergency surgery in field hospitals was 10.9 percent, against 1.9 percent in casualties evacuated to evacuation hospitals for treatment.

5. Of the 97.1 percent of wounded casualties who were treated in army hospitals and survived, about 17 percent were returned to duty from the army area. The remainder were evacuated to base hospitals.

TABLE 12.—*Distribution of 1,450 deaths from battle-incurred wounds in Fifth U.S. Army hospitals, 1 January 1944–2 May 1945, by location and type of wound* [1]

Location and type of wound	January–March 1944		April–July 1944		August–December 1944		January–May 1945		January 1944–May 1945	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Intracranial	97	18.3	81	16.8	57	20.1	46	29.7	281	19.4
Maxillofacial	1	.2	3	.6	1	.4	1	.6	6	.4
Cervical	8	1.5	10	2.1	2	.7	6	3.9	26	1.8
Spinal	7	1.3	4	.8	8	2.8	6	3.9	25	1.7
Thoracic	44	8.3	49	10.2	30	10.5	11	7.1	134	9.2
Thoracoabdominal	62	11.7	74	15.3	43	15.1	23	14.8	202	13.9
Combined thoracic and abdominal	18	3.4	17	3.6	10	3.5	8	5.2	53	3.7
Abdominopelvic	124	23.5	131	27.2	80	28.2	33	21.3	368	25.4
Extremities	83	15.7	58	12.0	28	9.9	9	5.8	178	12.3
Unclassified, multiple	83	15.7	55	11.4	25	8.8	12	7.7	175	12.1
Undetermined	2	.4	0	.0	0	.0	0	.0	2	.1
Total	529	100.0	482	100.0	284	100.0	155	100.0	1,450	100.0

[1] During this period, 1,562 U.S. battle casualty deaths were reported from Fifth U.S. Army hospitals, but the histories of only 1,450 were received in time to be included in this analysis.

VISITS TO ARMY MEDICAL INSTALLATIONS

As already mentioned, Major Snyder spent most of his time in the field, particularly in the period immediately after his appointment as consultant in surgery to the Surgeon, Fifth U.S. Army. At this time, there were numerous newly arrived hospitals in Italy, without previous combat experience, and it was essential that they be indoctrinated promptly in the principles and techniques of military surgery.

When this immediate emergency had passed, there were numerous other problems to solve, and, until the end of the war, Major Snyder continued the practice of visiting hospitals. As figures 73, 74, and 75 indicate, these visits were far too numerous to be recorded in detail within the limits of this chapter. The following summarized accounts, however, are representative of Major Snyder's activities during these visits.

95th Evacuation Hospital.—Major Snyder's first tour of Fifth U.S. Army medical installations after his appointment as surgical consultant to the army began with a visit to the 95th Evacuation Hospital in Naples on 13 and 14 October 1943. The method he employed there was substantially the same as that used in all his subsequent tours.

TABLE 13.—*Percentage distribution of principal causes of death in 1,450 battle casualties admitted to Fifth U.S. Army hospitals, 1 January 1944–2 May 1945* [1]

Causes of death	January–March 1944		April–July 1944		August–December 1944		January–May 1945		January 1944–May 1945	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Shock	183	34.6	194	40.3	91	32.0	55	35.5	523	36.1
Intracranial	65	12.3	66	13.7	45	15.8	36	23.2	212	14.7
Nephropathy	9	1.7	25	5.2	26	9.2	8	5.2	68	4.7
Peritonitis	13	2.5	26	5.4	19	6.7	7	4.5	65	4.5
Clostridial myositis	35	6.5	11	2.3	4	1.4	1	.6	51	3.5
Pneumonia	20	2.6	6	1.2	17	6.0	6	3.9	49	3.4
Fat embolism	5	.9	9	1.9	9	3.2	4	2.6	27	1.9
Thrombotic embolism	5	.9	12	2.5	1	.4	2	1.3	20	1.4
Spinal cord trauma	6	1.1	1	.2	6	2.1	3	1.9	16	1.1
Tracheobronchial obstruction, aspiration of vomitus	3	.6	1	.2	3	1.1	4	2.6	11	.8
Tracheobronchial obstruction, aspiration of blood and mucus	1	.2	4	.8	3	1.1	3	1.9	11	.8
Cerebral ischemia	2	.4	1	.2	2	.7	3	1.9	8	.6
Other	28	5.3	25	5.2	24	8.5	9	5.8	86	5.9
Undetermined	154	29.1	101	21.0	34	12.0	14	9.0	303	20.9
Total	529	98.7	482	100.1	284	100.2	155	99.9	1,450	100.3

[1] During this period, 1,562 U.S. battle casualty deaths were reported from Fifth U.S. Army hospitals, but the histories of only 1,450 were received in time to be included in this analysis.

His first conference, which was with the chief of surgery, consisted of an evaluation of the qualifications of the surgical personnel of the hospital and their assignments. He then made rounds with the chief of surgery and the other surgeons on the staff, discussing with them techniques of management of the various wounds encountered. He also observed operations. He lost no opportunity of talking informally to the members of the staff, doing a great deal of indirect teaching in this way.

At the conclusion of the visit, he met with the entire staff. The subjects discussed included the management of injuries of the extremities, with special emphasis on the importance of adequate debridement in those in which gas gangrene was a possibility; the routine in abdominal wounds and in chest surgery; the use of the sulfonamides (penicillin was not yet generally available); the importance of holding patients after surgery until they were safely transportable; and the importance of careful recordkeeping, his suggestions being based upon his random examination of the patients' charts.

36th Division.—Medical units of the 36th Division were visited during the period 25–27 October; a day was spent in each of the infantry regiments.

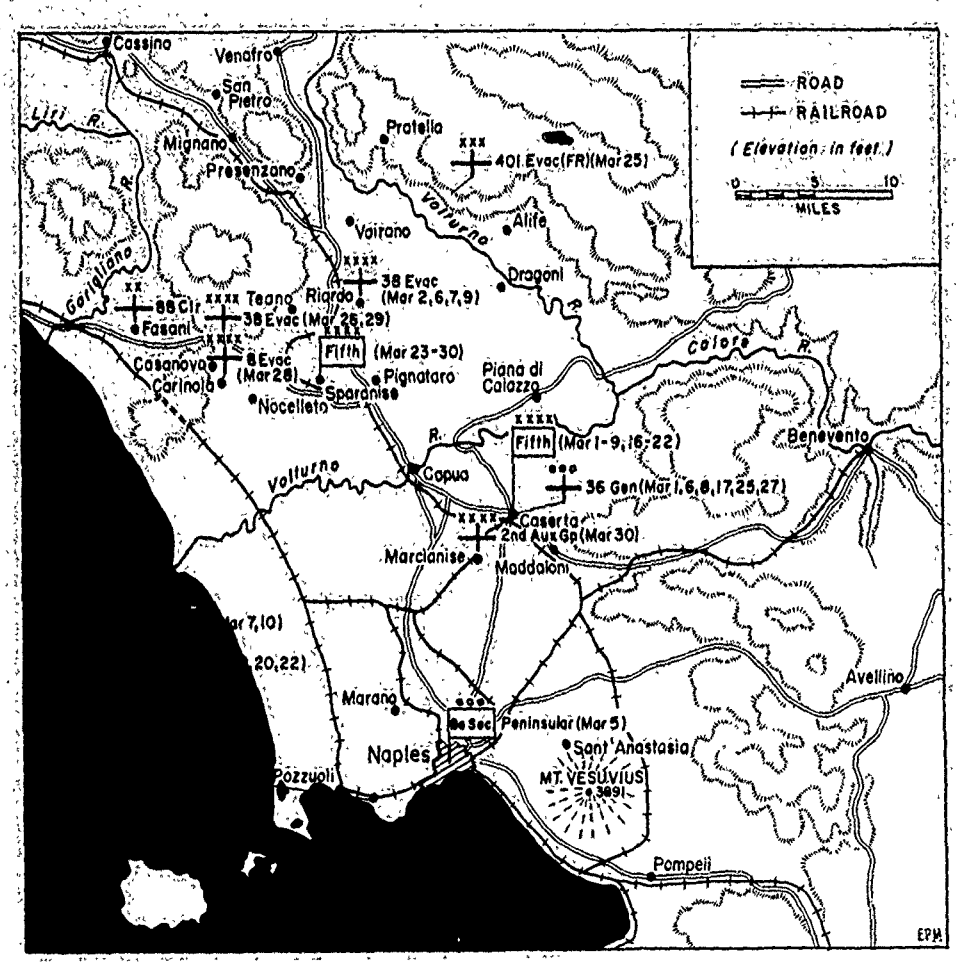


FIGURE 73.—Medical installations in Italy, visited by Maj. Howard E. Snyder, MC, during March 1944.

Here, Major Snyder talked to medical officers and first aid men on the use of Thomas' splint; the techniques of control of hemorrhage, with special emphasis on the dangers connected with the application of tourniquets; the precautions necessary in the use of morphine and the dangers of overdosage; and the importance of complete and accurate recording of the data required on the emergency medical tag. In his later talks with medical officers, Major Snyder reported to them on the surgery he had witnessed in hospitals in the theater. He recommended that they visit hospitals in the army area whenever the opportunity presented itself, so that they might see, in rear units, results of their own work in forward units.

On the third day of this tour, the division surgeon called a meeting of the regimental surgeons, the company commanders of the medical battalion, and

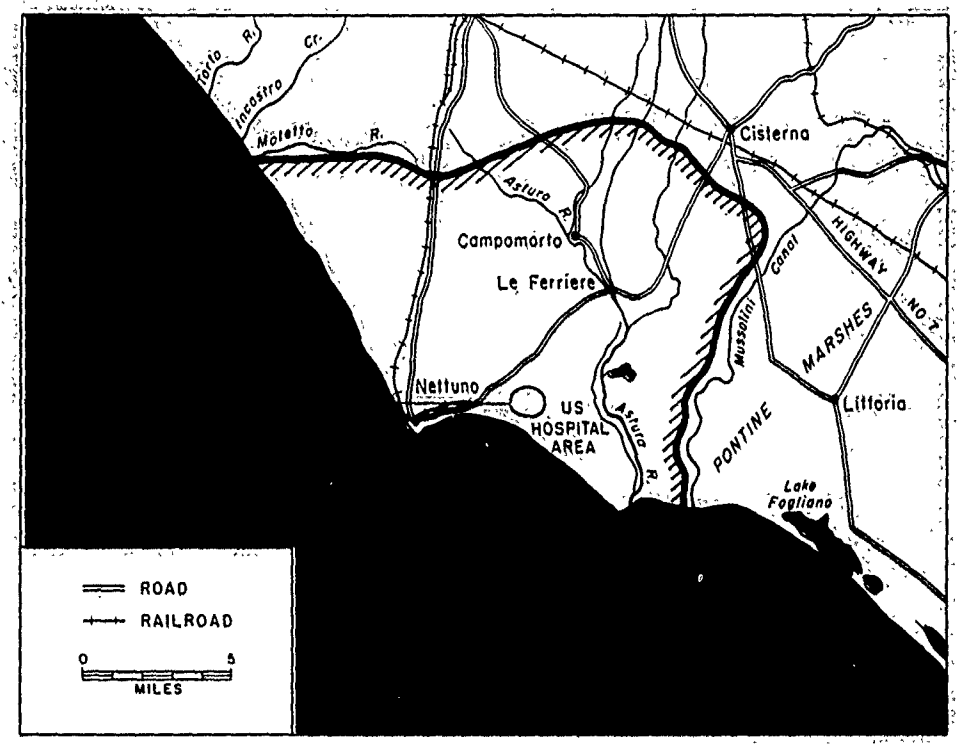


FIGURE 74.—Hospitals near Anzio, Italy, visited by Major Snyder during March 1944.

other medical officers for a general discussion of surgical problems in the division. The discussion covered gas gangrene; the use of tourniquets; the danger of circular bandages; the contraindications to packing of wounds; and the management of abdominal injuries in forward installations. It was arranged that battalion surgeons be equipped with 30-cc. syringes and ampules of serum albumin and with sulfadiazine crystals for intravenous use.

33d Field Hospital.—On 2 and 3 November 1943, Major Snyder with Captain Jergesen, visited the 2d Platoon of the 33d Field Hospital, which was located beyond Dragoni and west of Alife. The outstanding impression of this visit was the observation of an extremely severe case of clostridial myositis involving the right upper extremity and the chest wall.

On 6 November, the 3d Platoon of this same hospital was visited, with Maj. Henry K. Beecher, MC; this platoon was supporting the clearing station of the 45th Division south of Venafro. Although the hospital had not been very busy previously, Italian casualties from a mine explosion had been brought in just before these observers arrived, and there were so many serious chest and abdominal wounds associated with deep shock that an auxiliary surgical group team from the 94th Evacuation Hospital had to be brought up to help with the necessary surgery. Some of the surgery was excellent, some not so good. On

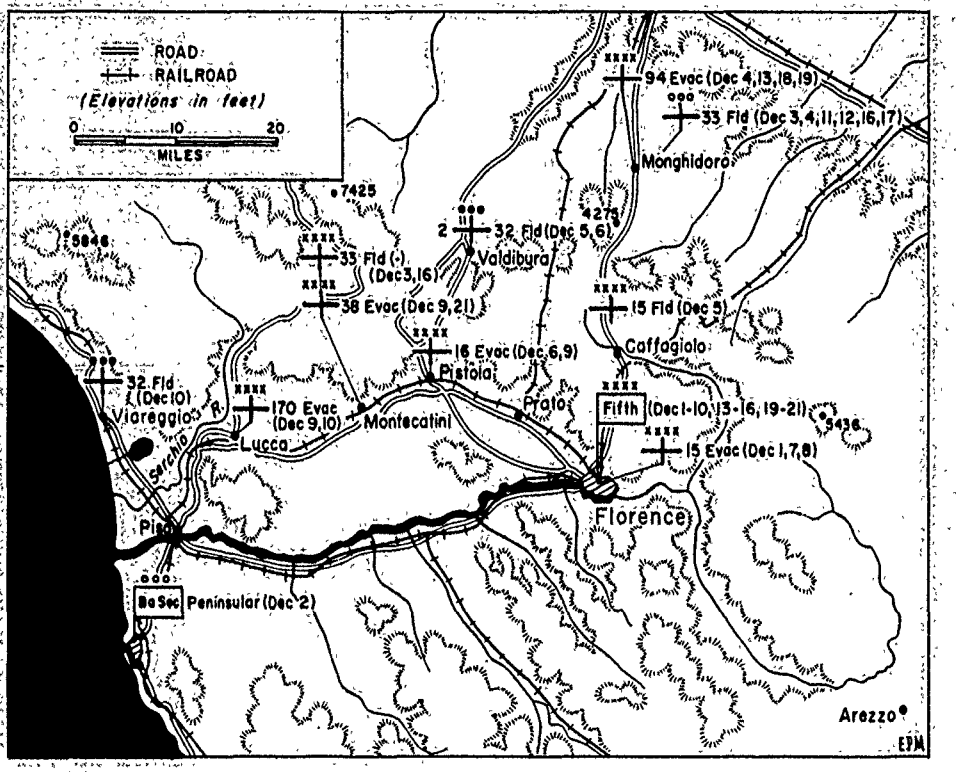


FIGURE 75.—Medical installations in Italy, visited by Colonel Snyder during December 1944.

the following day, a conference with the surgeons in this platoon was participated in by Major Beecher, Captain Jergesen, and Major Snyder. The importance of blood replacement was particularly emphasized. One patient with gas gangrene was observed at this platoon.

On 7 and 8 November, the 2d Platoon of the 33d Field Hospital, which was now near Pratella was revisited. Operation on a thoracoabdominal wound was observed, and the surgery on a complicated chest case was performed by Major Snyder, with Major Beecher giving the intratracheal anesthesia.

At this time, many of the hospitals were quite close together, and it was therefore possible, on 8 November, to conclude the visit at the 2d Platoon of the 33d Field Hospital, visit the 15th Evacuation Hospital that night and the next morning, and go on to the 93d Evacuation Hospital the following day, 9 November.

On 10 November, the 1st Platoon of the 33d Field Hospital was visited. It was set up adjacent to the 1st Division clearing station, near Venafro, about 4 miles from the frontlines. The clearing station was surrounded by a battery of British 5.5-inch guns, and the noise was terrific. Several patients who had been operated on were observed, all obviously in need of blood, more liberal

use of which was recommended. Several cases of gas gangrene were also observed. Captain Jergesen talked to the staff on anaerobic infections, and Major Beecher spoke on blood transfusions.

A brief visit to the 94th General Hospital on the afternoon of 10 November ended this particular tour of army hospitals. On many other tours, quite as many installations were visited.

The Anzio beachhead.—The first of the nine trips which Major Snyder made to the Anzio beachhead after the landings there on 22 January 1944 lasted (including the travel time from Naples to the beachhead and return) from 6 February to 10 February, inclusive. Two other trips were made in February, one in March, one in April, three in May, and the last in June. All of these trips were for periods of several days, and between 23 May and 6 June Major Snyder was continuously on the beachhead.

The first trip from Naples to Anzio was complicated by a German air raid just as the LST docked at Nettuno. The Germans were shelling the docks at rather frequent intervals, and bombing continued off and on during Major Snyder's inspection of the 33d Field Hospital and the 56th, 93d, and 95th Evacuation Hospitals, which were grouped together a few miles from the beach. The casualties from these raids have already been described (p. 346).

On his second trip to the beachhead, from 13 through 17 February 1944, Major Snyder began to take his turn at the operating table, as he did on subsequent visits.

The final offensive on the Anzio beachhead was launched on 23 May 1944. As soon as word of it was received, Major Snyder went up by the first available transportation (LST). Casualties were heavy, and immediately on his arrival, after he had made rounds at the 33d Field Hospital and the 11th, 15th, 38th, and 94th Evacuation Hospitals, he began to assist with the heavy backlog of operations at the 38th Evacuation Hospital. For the first 48 hours, he and Captain Jergesen operated together. Then each of them acquired an assistant and worked separately. During this period, Major Snyder made daily morning and evening rounds in all the hospitals in the area.

Shortly after the fall of Rome, on 4 June 1944, the 38th Evacuation Hospital was set up in Rome, and Fifth U.S. Army headquarters were moved to Anzio. Thus, one phase of the medical responsibility in Italy ended.

Section II. Clinical Considerations

EVOLUTION OF CLINICAL POLICIES

Principles of Surgical Care

In the first weeks of the fighting in North Africa, there were few specified clinical policies. Surgeons chiefly employed the techniques which they had found satisfactory in clinical practice. The results, however, were often not as good as they should have been because (1) combat-incurred wounds differ

in extent and severity from most peacetime wounds and (2) the circumstances of military surgery differ materially from those of civilian surgery.

The chief difference between military and civilian surgery is that in civilian surgery a single surgeon usually makes all the decisions for a single casualty while in military surgery the decisions are made by a number of surgeons. From the time a wounded soldier was tagged on the battlefield or in a battalion aid station of the Fifth U.S. Army until the completion of the cycle of treatment, evacuation, and disposition, he was cared for by a series of surgeons in a series of installations. The judgment and decisions of many medical officers were interwoven in the threads of his recovery. Every surgeon who treated him was called upon not only to evaluate the patient's status but also to estimate his own surgical capabilities and limitations and the facilities at hand to perform the necessary surgery. All decisions had to be made in the light of circumstances peculiar to a field army in combat.

The whole system of medicomilitary care was based on the premises that medical care is accomplished in echelons; that the mission of each echelon is both specified and limited; and that all medical officers must not only perform the duties specified for them but must also limit themselves to the duties specified for that particular echelon.

Fifth U.S. Army surgeons were allowed and expected to exercise resourcefulness and ingenuity. They had ample freedom to act in emergencies in the light of their professional experience and judgment. The system was flexible, but it remained a system, based upon general principles which surgeons were expected to apply to particular cases unless there was some very good reason indeed for not doing so. Furthermore, it was always essential that surgeons who had deviated from what was considered standard practice to make clear the extent of the deviation and the reason for it.

Establishment of Priorities

On the basis of triage at the clearing station, casualties were divided into nontransportable patients, who made up about 10 percent of all casualties, and transportable patients. Categories could not always be defined with exactitude, but they served as useful guides. Once they had been established during the fighting in Sicily, as set forth in Circular Letter No. 3, Office of the Surgeon, Headquarters, II Corps, dated 7 August 1943,[22] they remained substantially unaltered during the course of the war.

First priority cases.—In this letter, first priority cases were specified as follows:

1. Severe shock or continuing hemorrhage after temporary resuscitation in a clearing station.

2. Compound fractures of long bones complicated by shock or hemorrhage, or fractures which had not been completely and comfortably immobilized.

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[22] See footnote 8, p. 361.

3. Wounds of the extremities in which the blood supply was impaired or similar wounds in which it would be necessary to evacuate the casualty with a tourniquet in situ.

4. Wounds characterized by extensive muscle damage, especially wounds of the shoulder girdle, thighs, or calves, in all of which clostridial myositis was a serious possibility.

5. Traumatic amputations.

6. Head injuries associated with deep coma or with signs of increased intracranial pressure.

7. Maxillofacial wounds or wounds of the neck of special severity or associated with respiratory difficulties.

8. Sucking chest wounds and any other chest wounds associated with respiratory difficulties.

9. Thoracoabdominal wounds.

10. Abdominal wounds and wounds of the buttocks which might have penetrated the abdomen or the rectum.

Second priority cases.—Casualties with the following types of wounds were transferred directly from clearing stations to evacuation hospitals without passing through the field hospitals:

1. Simple fractures and compound fractures of long bones in which the patients were transportable (that is, they were not in shock and had no other injuries which made them nontransportable) and in which satisfactory immobilization had been accomplished or could be accomplished in the clearing station.

2. Peripheral nerve injuries, if not complicated by compound fractures or extensive muscle damage.

3. Craniocerebral injuries which were not associated with coma or signs of intracranial pressure.

4. Chest wounds which were not sucking and were not associated with respiratory difficulties.

It is characteristic of the ubiquity of the disease even in wartime that it was specified that patients with early acute appendicitis or with possible appendicitis should be transferred to evacuation hospitals for surgery.

SHOCK AND HEMORRHAGE

Special Studies in Shock

The steady decrease in the number of battle casualties who died in Fifth U.S. Army hospitals before they could be operated on or even anesthetized is a reflection of the steadily increased effectiveness of the management of shock during the fighting in Italy. A number of medical officers played a special part in this improvement. A discussion of their achievements follows.

The first scientific appraisal of shock in the Fifth U.S. Army was begun by Captain Lalich on the Cassino front in December 1943. In March 1944, on

the Anzio beachhead, he was provided with sufficient laboratory equipment by Colonel Cornell, Commanding Officer, 15th Medical General Laboratory, to make the detailed studies necessary to support his thesis that blood loss is the chief factor in shock. His laboratory investigations included determinations of the hematocrit, the plasma protein, the nonprotein nitrogen of the blood and blood chlorides, and the carbon dioxide combining power of the blood.

On the basis of clinical observations alone, Captain Lalich had already advocated that battle casualties who were in shock be divided into three categories, according to the following criteria:

1. The patient has a normal blood pressure, with no significant abnormalities in pulse volume or pulse rate, but his wounds are sufficiently numerous, and of sufficient gravity, to make expectation of circulatory failure reasonable. Replacement therapy in the amount of 500 cc. of plasma and 500 cc. of blood should therefore be instituted before surgery.

2. The blood pressure ranges from 90 mm. Hg down to the lowest level at which it can be demonstrated. Resuscitation requires 1,000 to 2,000 cc. of blood.

3. The blood pressure cannot be determined by auscultation. The patient should receive, immediately and rapidly, 500 to 1,500 cc. of blood, the precise amount depending upon how much is needed to raise the systolic pressure to about 100 mm. Hg. After this level has been reached, an additional 500 to 1,000 cc. of blood should be given before the patient is put on the operating table. If the systolic pressure fails to rise to at least 50 mm. Hg after 1,500 cc. of blood has been given over a period of 15 to 30 minutes, operation should be resorted to without further delay, for continuing hemorrhage or factors other than blood loss are probably contributing to the continuing shock. Among these factors are gross contamination and infection of the pleural or peritoneal cavities and toxemia from clostridial myositis. Even when these conditions are chiefly responsible, blood loss may also play some part in the patient's state of shock.

The second study on shock was conducted by Lt. Col. John D. Stewart, MC, and Lt. (later Capt.) Frank B. Warner, Jr., MC. It was begun in January 1944, when Mobile Unit No. 3, 2d Medical Laboratory, was set up at Cassino, beside the 3d Platoon of the 11th Field Hospital. This hospital was doing first priority surgery, and the objective of the investigation was to study the response of seriously wounded men from the standpoint of shock, hemorrhage, and dehydration.

In the preliminary report of this study to the Surgeon, NATOUSA, through the Surgeon, Fifth U.S. Army, dated 17 March 1944, the following findings were listed as characteristic of shock:

1. Absence of hemoconcentration.
2. Reduction in the blood volume.

3. A greater reduction of red cell concentration than of plasma protein concentration immediately after wounding.

4. A later lowering of both red cell and plasma protein concentration.

5. Frequent delayed dehydration.

Attention was called in this report to the variability of both vasomotor and cardiovascular responses to wounding and to the fact that the reactions to shock and hemorrhage were much less stereotyped than had usually been supposed.

The original observations of Major Stewart and Lieutenant Warner were based on a study of 35 desperately wounded casualties operated on at the 11th Field Hospital as well as of several patients with gas gangrene. Studies had also been made on blood specimens provided by other hospitals nearby. The surgical staff was kept informed of all laboratory findings and was able to use the information in the management of its cases.

In their final report on 2 January 1945, Colonel Stewart and Captain Warner discussed observations on 100 patients, of whom 48 had penetrating abdominal wounds, 32 had penetrating thoracic wounds, and 55 had compound fractures (the figures are overlapping); 17 had died during the period of the investigation. In addition to the studies already listed, special studies on the urine were included in this report.

Conclusions from the total study were as follows:

1. The syndrome of wound shock was notable for its variability.

2. Reduction in blood volume was characteristic of untreated shock.

3. Hemoconcentration was not encountered, but decreases in plasma protein concentration and hematocrit readings were evident from the outset.

4. Dehydration and azotemia were common in the early recovery period.

5. The urinary reactions were indicative of a rather mild base deficiency.

6. No evidence of excessive use of plasma or whole blood was detected.

A third study of shock was made at Cassino and on the Anzio beachhead by Maj. Henry K. Beecher, MC, Consultant in Resuscitation and Anesthesia, NATOUSA, and Capt. (later Maj.) Charles H. Burnett, MC. Most medical officers who had studied shock believed that it was wiser to resuscitate the patient as completely as possible before placing him on the operating table unless there was evidence that continuing blood loss or some one of the other factors just listed was responsible for his condition. As a result of this study, Major Beecher and Captain Burnett took the contrary position. Their concept was that surgery be considered a phase of the program of resuscitation and given an earlier place in it. This meant that, when the systolic blood pressure had reached 80 mm. Hg and the patient was warm and had a good color, he should be placed on the operating table without further delay. Whatever additional blood replacement might be necessary could be accomplished during the operation. Some medical officers agreed with this concept and put it into practice, but it did not win general acceptance.

The Board for the Study of the Severely Wounded made great contributions to the study of shock, crush injuries, and nephropathies.[23]

Captain Lalich's investigations constituted the first scientific study of shock in battle casualties in World War II. His studies, together with those conducted by Major Stewart and Captain Warner, showed that blood loss, with a resultant decrease in the circulating blood volume, is the most important cause of shock in battle casualties. These observations were confirmed by the work of Major Beecher and Captain Burnett and by the Board for the Study of the Severely Wounded. The practical application of their observations placed the management of shock upon a rational basis and was responsible for the saving of many lives.

Principles of Resuscitation

Rapid, complete examination of the casualty in shock was an immediate necessity, to determine the conditions present which might be contributing to his status, so that immediate steps could be taken to correct or control them. Among the shock-producing conditions likely to be found were the following:

1. Cardiorespiratory embarrassment from painful wounds of the chest wall; sucking wounds; hemothorax; pneumothorax and tension pneumothorax; cardiac tamponade; paradoxical respiration; accumulation of blood, mucus, or both in the tracheobronchial tree; and anoxia from any of these causes.
2. Continuing hemorrhage.
3. Large soft-tissue wounds and inadequately immobilized fractures.
4. Wound sepsis, including clostridial myositis.
5. Gross contamination of the peritoneal cavity in abdominal wounds.

The measures to control and correct these conditions included maintenance of a patent airway; postural or suction drainage of tracheobronchial secretions; closure of sucking chest wounds; relief of hemothorax or tension pneumothorax; oxygen therapy; and conservation of body heat.

Whatever the contributory cause, however, the underlying cause of shock in most cases was blood loss, either alone or associated with one or more of the factors just listed. The regimen of resuscitation was a complex affair, but the keystone of the arch was the administration of whole blood.

Resuscitation was not an end in itself. It was a means to an end. The end was the operation, which was imperative in the control of hemorrhage, peritoneal contamination, and numerous other conditions and which was an essential part of the management of all cases. Timing was important. When the patient had reached an optimum stage of recovery, it was essential to take advantage of the moment and operate at once, for the status of a wounded casualty was never static, and deterioration was the rule if surgery was too long deferred. Once the patient had slipped back into shock, secondary

[23] See footnote 18, p. 398.

resuscitation was more difficult than primary resuscitation, and many experiences suggested that it was never as satisfactory.

DEVELOPMENT OF THE BLOOD PROGRAM

North Africa

U.S. medical officers found, as soon as they began to care for casualties in North Africa, how essential whole blood was both for freshly wounded casualties and for those whose wounds were older. When U.S. Army hospitals landed and began to operate the hospitals in Oran, plasma was available to them in large quantities, but most of them had come overseas with limited equipment for transfusion or none at all. In the 77th Evacuation Hospital, in which Major Snyder was in charge of chest surgery, the only equipment available for transfusion was that which Captain Lalich, who headed the shock team, had secured from the British blood bank in England. The hospital had neither citrate nor distilled water and had no facilities to make the latter. Sodium citrate was obtained from a French pharmacy, a still was borrowed from the French, blood was obtained from the hospital detachment, and the casualties cared for in this hospital received more whole blood than plasma.

The need for whole blood transfusions in the management of combat casualties and the extreme inadequacy of the equipment for transfusions were reported to the Surgeon, II Corps, early in December by the chief of surgery of the 77th Evacuation Hospital through channels. Major Snyder also emphasized the importance of whole blood in his critique of surgery in clearing stations in North Africa for the Surgeon, II Corps, in March 1943 (p. 372). In his report, he stated that (1) a shock team should be part of the personnel assigned from an auxiliary surgical group to a clearing station, (2) a more convenient method of blood transfusion should be made available, and (3) a source of blood other than clearing station personnel should be provided.

Sicily

When Circular Letter No. 3, Office of the Surgeon, Headquarters, II Corps, was published on 7 August 1943 (p. 361), plasma was still considered to be the most effective weapon for combating shock, though it was noted that, when hemorrhage was a major factor in the patient's status, whole blood should be used as soon as crossmatching could be completed. It was also directed that both blood and plasma be used without delay and in sufficient quantities to accomplish resuscitation, even if this took large amounts. Finally, it was emphasized that, once the patient had been satisfactorily resuscitated, he must not be allowed to slip back into shock, since secondary resuscitation was less effective and more difficult than primary resuscitation.

During the fighting in Sicily, blood donors, as in North Africa had to be secured from the personnel of hospital units or from neighboring service units. Transfusion sets, also as in North Africa, had to be prepared, cleaned, and sterilized by hospital personnel. The frequency of malaria reduced the list of available donors, but volunteers, on the whole, responded generously, and the hospital chaplains rendered effective aid in keeping donors continuously available.

Fifth U.S. Army

By the end of 1944, most hospitals in the Fifth U.S. Army had established their own small blood banks, in which type-specific blood was held for 24 hours, or, occasionally, a little longer. In a few hospitals, the administration of blood at this time averaged 0.5 to 0.8 pint per casualty, but as a rule the rate was far below this. As Major Snyder went from hospital to hospital, it was easy for him to tell from the appearance of the patients after operation whether they had received sufficient blood; if they had not, they looked white and bled out. In almost all hospitals in the winter of 1943–44, it was necessary to urge medical officers to use blood more liberally.

In February 1944, a central blood bank, designed to supply whole blood to the Fifth U.S. Army, was organized to supply whole blood for Fifth U.S. Army installations, chiefly through the work of Maj. (later Lt. Col.) Eugene R. Sullivan, MC. Field and evacuation hospitals were thus relieved of the difficult task of drawing their own blood in the quantities then being used in forward surgery, and the always undesirable practice of bleeding line and service troops in forward areas was also ended. This organization, officially designated as the 6713th Blood Transfusion Unit (Provisional), was attached to the 15th Medical General Laboratory in Naples, under the command of Colonel Cornell.

In April 1944, a program was set up by which a medical officer from each army hospital and a technician from each hospital laboratory were sent to Naples for 3 days of intensive instruction at the blood bank. Handling of the banked blood at the individual hospitals was much improved as a result of these courses.

Anzio beachhead.—The first blood provided by the blood bank at Naples went to the Anzio beachhead, on 25 February 1944. Up to this time, whole blood had been provided to both British and U.S. Army hospital units by the British 12th Field Transfusion Unit. The initial 200 pints of blood brought in on the day of the landing, 22 January, had been used up by 27 January. Thereafter, an average of 100 pints a day was brought in, usually by LST's, occasionally by small planes which could land on the airstrip without drawing German fire. It was the responsibility of the two enlisted men who checked all incoming supplies to watch for the shipments and to arrange for their immediate dispatch by truck to the medical dump. The blood was held there until it was called for by the British transfusion unit, which con-

tinued to store the blood and distribute it to the hospitals. The performance of this unit was highly efficient.

Before the breakout at Anzio, it had become evident that the 6713th Blood Transfusion Unit would not be able to supply as much blood as would be needed for the casualties expected. With General Martin's approval, Major Snyder discussed the problem with Lt. Col. (later Col.) Kenneth F. Ernst, MC, Commanding Officer, 2d Medical Laboratory (a Fifth U.S. Army unit). He agreed to supply an additional 100 pints of blood daily. He was able to secure the necessary equipment and supplies, and on 26 May 1944, to the surprise and gratification of the surgeons on the beachhead, he delivered the first 100 pints. The same supplement was received daily until the need for it no longer existed. This laboratory could have supplied more blood if it had had more donor sets. As it was, it had to stop in the middle of the day to resterilize its equipment.

Between 22 January and 4 June 1944, 10,624 pints of blood were used in U.S. Army hospitals on the beachhead, an average of 1 pint for each 2.01 battle casualties, and 3,685 pints were used in British hospitals, an average of 1 pint for each 2.95 casualties.

Use of Blood

From the time the Naples blood bank began to operate, field hospitals were always supplied with all the blood they required. Evacuation hospitals, for a time, continued to operate their own blood banks when the casualty load was not heavy. When it was, their supplies were augmented with blood from the base bank. Later, these hospitals were also supplied with all the blood they needed from the blood bank. In July 1944, when the advance up the peninsula was rapid, forward hospitals sometimes ran out of blood; when they did, a supply was promptly flown in by cub plane.

As a rule, clearing stations were not supplied with blood. On a few occasions, however, as when the advance was particularly rapid after the breakout from Anzio, blood was used in some of the clearing stations which were well ahead of field hospitals. There were no untoward results, but when field hospitals were abreast of clearing stations there was no real need for this practice.

Blood was used with more and more liberality as the months passed, and its value was increasingly appreciated. This was true in all echelons of medical care. In the last 4 months of 1944, 9,903 pints of blood were given to 15,553 casualties admitted to Fifth U.S. Army hospitals—0.63 pint per casualty. In 1945, before the fighting in Italy ended, the ratio was 1 pint per casualty.

Blood was used with equal liberality in general hospitals. Colonel Hampton and Major Lyons, for instance, in their demonstration of correct surgery of the extremities at the 21st General Hospital in the fall of 1944, reported the daily use of 1,000 cc. or more in septic patients, in order to bring the hematocrit and plasma protein to normal levels.

Colonel Snyder and Captain Culbertson, in their study of combat fatalities in Fifth U.S. Army hospitals, provided the following data on the use of blood and plasma:

1. Of all wounded patients treated in field hospitals, about 70 percent required blood transfusions and about 63 percent required plasma. An average of 3 pints of blood was given to each patient who required blood and an average of 2.5 units of plasma to each patient who required plasma.

2. In evacuation hospitals, about 20 percent of the patients required blood transfusions. Each of them received an average of 2 pints. About 15 percent of the patients required plasma, and each of them received an average of 2.5 units.

The superior management of the blood bank established at Naples and the unlimited quantities of blood which it supplied contributed greatly to the improved results of combat surgery in the Mediterranean theater in the last year of fighting. The medical officers who headed shock teams and supervised resuscitation of shocked patients developed great skill and judgment in the preparation of battle casualties for surgery, and the saving of many lives can be attributed to their fine work.

BLOOD REPLACEMENT THERAPY

Techniques

Once it was realized that shock was chiefly due to loss of blood, restitution of the depleted blood volume was recognized as the principal component of resuscitation. Plasma was used from the battlefield through the clearing station, in sufficient quantities to render the patients transportable to hospital installations. Thereafter, whole blood was chiefly used except in burns, in which, logically, plasma was employed in large quantities, particularly immediately after injury.

When the patient was in severe shock, 1,000 cc. of whole blood was given rapidly into two veins, under positive pressure. In extremely urgent cases, when the blood pressure could not be obtained at all, the first 1,000 cc. of blood was administered without crossmatching; since all blood used was low titer group O blood (p. 420), this expedient was regarded as safe, at least under the circumstances. After the systolic blood pressure had reached 80 mm. Hg, the rate of the transfusion was reduced. When the pressure approximated normal (100 mm. Hg or higher), an additional 500 cc. of blood was administered unless there was some urgent reason for operating immediately. The rationale of this practice was that a systolic blood pressure in the neighborhood of normal was often attained before the depleted blood volume had reached a satisfactory level.

Blood replacement was frequently continued during operation unless exploration of an abdominal wound revealed that peritoneal contamination was

the principal factor responsible for shock; in these circumstances, if there had not been a considerable loss of blood, plasma could be used.

Long before the end of the war, copper sulfate solutions were in universal use for the determination of hemoglobin, hematocrit, and plasma protein values in battle casualties. The procedure was standard in both field hospitals and evacuation hospitals and proved extremely valuable in estimating the nutritional state of patients after operation. This useful development grew out of the work of Captain Lalich on the Anzio beachhead (p. 412).

Reactions

The blood sent from the Naples blood bank to the Anzio beachhead was all type O. One set of recipient tubing was furnished with each two bottles of blood. There were no serious reactions, but a few patients had mild attacks of shivering or slight chills. When this happened, the transfusion was continued from another bottle of blood, the partially used bottle being employed for another casualty.

In April 1944, anuria was reported in a number of casualties who had been transfused with untitered group O blood. Shortly afterward, a serious reaction was reported in a group A recipient who had received 2,500 cc. of group O blood. Major Snyder at once initiated discussions with Major Beecher, Captain Burnett, Captain Lalich, and others who had made special studies of shock and resuscitation. Captain Lalich reported the development of urinary difficulties in a number of individuals with cases of shock which he had investigated. They were by no means universal, but they had occurred, and some of them had been serious. He did not think, however, that sufficient evidence had yet been accumulated to inculpate group O blood or to ask that the blood bank furnish type specific blood. Others in the group thought that this request should be made immediately. These reactions were also discussed with officers at the 15th Medical General Laboratory.

It was agreed, as the result of the conferences, that low titer group O blood should be given a further trial before any change in the present policies was instituted. As a precaution, all blood with an anti-A or anti-B titer over 1 : 250 was to be marked "For group O recipients only."

On 1 May 1944, when Major Snyder visited the 33d Field Hospital on the Anzio beachhead, he received reports of two deaths in group A recipients who had received group O blood. Most medical officers were now convinced that the use of group O blood in group A recipients was unsafe and should not be continued. Major Beecher returned to Naples, to discuss the matter further with officers in the blood bank there, and it was agreed that sufficient evidence was now at hand to warrant a change in policy and the supplying of group A blood for A recipients. It was also agreed that a circular letter should be prepared to accompany the shipments of group A blood.

Before these arrangements could be consummated, the decision was reversed; and the Surgeon, Fifth U.S. Army, was informed by radiogram from

the Commanding General, NATOUSA, that hereafter the base collecting section of Blood Transfusion Unit 6713 would furnish the Fifth U.S. Army installations with only one type of blood, group O, with an agglutinin below 1:64. It was indicated that this radiogram was for action by the Commanding Officer, 15th Medical General Laboratory.

There were two reasons for this decision. One was the fear that more deaths might be caused by errors in crossmatching if both group A and group B bloods were supplied than would occur if group O blood titered for anti-A and anti-B agglutinogens continued to be used. The second was the possibility that group A blood might be administered through tubing through which plasma was running, with resultant serious reactions.

In a return radiogram, the commanding officer of the 15th Medical General Laboratory made the following points:

1. Rigid compliance with the order received might necessitate discarding half the O blood drawn. In the past, O blood with an anti-A titer of 1:250 or over had been marked "For group O recipients only." These bloods had comprised only about 15 percent of all bloods drawn. The order in the wire from NATOUSA precluded the use of O blood with a titer of over 1:64 for anyone. Immediate authority was requested to use group O blood for O recipients, regardless of titer.

2. Four histologically proved cases of fatal hemoglobinuric nephropathy were known to have followed the use of group O blood for A recipients. In two of these fatalities, only low titer blood had been used. Major Beecher had information of other clinical cases in which the circumstances were similar, and he had ceased to use group O blood for group A recipients.

An immediate investigation by Colonel Churchill was requested, with authority to modify or revoke the order of 13 May from theater headquarters. The matter was finally resolved by continuing, as in the past, to use group O blood of any titer for O recipients and to mark all blood with an anti-A or anti-B agglutinogen titer of 1:250 or more "For group O recipients only."

CHEMOTHERAPY AND ANTIBIOTIC THERAPY

The Sulfonamides

Because penicillin was not available during the fighting in North Africa and was available only in limited quantities and for strictly limited use in Sicily and in the first months of the fighting in Italy, sulfonamide therapy was used both locally and systemically during this period.

The studies of Major Stewart and his associates on shock (p. 413) included determinations of the sulfonamide levels in the blood. In both the preliminary and the final reports, these observers called attention to the erratic and uncertain blood sulfonamide levels. They warned that this unpredictability should be kept in mind in any appraisal of the presumed benefits of routine sulfonamide

therapy in severely wounded men. If both overdosage and ineffective levels were to be avoided, sulfonamide therapy must be controlled by blood determinations.

The local use of the sulfonamides became more infrequent as the war progressed. Opinions concerning the value of this route had differed widely. A few surgeons considered local sulfonamide therapy of great value, a number considered it harmful, and the majority believed that it made no difference whether or not it was used.

The possible implication of sulfonamide therapy in lower nephon nephrosis is discussed under "Complications, Anuria and Nephropathy."

Penicillin

When penicillin first became available in Sicily in the summer of 1943, its use was limited to the treatment of clostridial myositis. It was also used only on this indication in the first months in Italy. The routine of securing it was quite complicated. It was distributed by the 15th Medical General Laboratory in Naples, which served as a depository for it, and it had to be secured by requisition from certain designated hospitals in the army area. When it was needed at the 15th Evacuation Hospital on the Anzio beachhead, for instance, it was necessary for the chief of surgery there to call Lt. Col. (later Col.) Phillip W. Mallory, MC, Executive Officer, the 56th Evacuation Hospital, each time he needed a supply.

By the spring of 1944, penicillin had become available in sufficient quantities to be used in all wounds in which it was indicated. Meantime, at the 21st General Hospital, Major Lyons, consultant in penicillin therapy, and Major Hampton had set up a septic ward in which they were demonstrating a threefold program in the surgery of the extremities, consisting of adequate debridement, liberal blood transfusion, and penicillin therapy (p. 359). Penicillin was given in dosages of 200,000 Florey units daily (25,000 units every 3 hours) by the intramuscular route. At the suggestion of these observers, this regimen was instituted in all field and evacuation hospitals as soon as the casualty was admitted. The operating surgeon decided whether to continue the use of penicillin after operation.

Penicillin was sometimes used intraperitoneally in abdominal injuries, occasionally in combination with the local implantation of sulfanilamide powder or crystals. Opinions concerning its value by this route differed as widely as opinions concerning the local use of sulfanilamide. There was general agreement, however, that penicillin was of great value when used locally in the pleura and the joints.

Penicillin was introduced at about the time forward surgery was greatly improved, particularly in respect to more adequate debridement, with greater emphasis upon the removal of all devitalized tissue. This was also the period in which blood began to be used in generous quantities and in which delayed

primary wound closure was generally employed in base hospitals. The policy of wound closure, which was highly successful, was possible because most of the wounds looked and were healthy and clostridial myositis had ceased to be the threat it had been earlier. Penicillin was given, and deserved, a considerable share of the credit for these achievements. Knowledgeable surgeons continued to insist, however, that good surgery was the basic reason for the improvement in results, and there is no doubt that their emphasis upon it was entirely justified.

SPECIAL TYPES OF WOUNDS AND INJURIES

Soft-Tissue Injuries and Fractures

Initial wound surgery.—The principles of initial wound surgery, particularly the importance of adequate debridement, had been thoroughly taught before the war and were fully appreciated from the beginning of the fighting in North Africa. Certain practices were introduced, and others were modified, but the fundamental principles remained unchanged. As the war progressed, however, these principles were more generally and more correctly applied.

Circular Letter No. 3, Office of the Surgeon, Headquarters, II Corps, dated 7 August 1943,[24] gave the following directions for the management of wounds produced by high explosive shell fragments:

1. All foreign bodies should be localized by fluoroscopy before operation.
2. Devitalized and contaminated skin should be excised, but healthy skin should not be sacrificed.
3. The skin wound should be enlarged by appropriate incision to permit exposure and excision of all underlying devitalized and contaminated tissue and to provide adequate drainage to the depths of the wound. This required similar incision of the fascial plane.
4. Foreign bodies, which frequently carried in bits of clothing, dirt, and other foreign material, should be removed.
5. When debridement had been completed, raw surfaces should be dusted with sulfanilamide powder, and fine-mesh petrolatum-impregnated gauze should be placed loosely in the wound.
6. The wound should never be sutured primarily.

Changes in this technique were as follows:

1. Fasciotomy proved a very useful method in hematomas of the leg and in wounds associated with swelling and with impairment of the blood supply. It was performed at initial wound surgery or later according to the indications of the special case.
2. The type of incision based on the Z-plasty incision employed in plastic surgery proved very useful in extensive injuries in areas in which there was

[24] See footnote 8, p. 361.

little excess of skin. Each limb of the incision was begun at the opposite corner of the traumatic incision. Delayed primary wound closure was greatly facilitated when this incision was employed in the types of wounds mentioned.

3. After January 1944, fine-mesh dry gauze began to be used in wounds instead of petrolatum-impregnated gauze.

The circular letter published in August 1943 stated that little or no debridement was necessary in through-and-through wounds produced by high-velocity bullets. This did not prove a satisfactory policy. Later, it became the practice to make a sufficiently long incision through the skin and fascia in this type of wound to permit a search for possible muscle damage. If no damage was found, nothing further was done. If damage was found, debridement was proceeded with according to the usual technique.

The principles of adequate debridement of high explosive wounds of the extremity were, as already mentioned, known before the war, and they were emphasized throughout the war. They never changed. The problem was not the management of these wounds. It was teaching inexperienced surgeons and staffs of newly arrived hospitals to follow these principles and practices. That these principles and practices be followed was essential, for the whole program of reparative surgery (delayed primary wound closure) was based upon the adequacy of initial wound surgery.

Fracture management.—The management of compound fractures at initial wound surgery was limited to the correction of gross malposition. Definitive reduction was not the function of an army hospital. Roentgenologic controls were not feasible in a forward hospital, and, even if precise reduction could have been maintained during the application of transportation splinting, it would probably have been lost when the cast was split or bivalved, as was the fixed rule in forward areas, to guard against circulatory impairment during transportation. Definitive reduction, by whatever method was indicated, was the function of the general hospital, at reparative surgery.

Removal of totally detached bone fragments was part of initial wound surgery. All large fragments whose removal would have created a segmental bony defect were left in situ, as were all small fragments which had any attachment at all.

Delayed primary wound closure.—Closure of the wound was the function of general hospitals in the base but was occasionally completed on minor wounds in convalescent hospitals in the army area. The wound was inspected in the operating room, and if it looked clean and healthy it was closed by interrupted sutures. Contraindications to closure included infection; the presence of necrotic tissue in more than minimum amounts (small fragments of necrotic tissue were excised); and inability to secure closure without tension unless a skin graft was employed. Wound healing was usually prompt and satisfactory if initial wound surgery had been adequate.

Most surgeons preferred to perform delayed primary wound closure within 4 to 10 days after wounding. As experience was accumulated, the earlier timing came to be considered more desirable.

When Dr. Allen Whipple visited North Africa in the fall of 1943 (p. 368), he had just returned from observing British surgery in the Far East. British surgeons ascribed their success in delayed primary wound closure to the local use of penicillin. Under Colonel Churchill's direction, a number of U.S. Army surgeons at the Bizerte medical center had been trying out this technique, but without using local antibiotic or other therapy. After Dr. Whipple had observed the outcome of these cases, he concluded that penicillin had nothing whatever to do with the results he had observed in British hospitals and agreed with U.S. Army surgeons that their good results were due to good surgery alone.

Splinting and casting.—The primary splinting applied in fractures of the extremities was, like the first dressings, intended to serve until the patient reached a hospital in which surgery could be performed. This was not always practical; improvised splinting frequently had to be employed to remove the patient from the battlefield to the battalion aid station. In any event, whatever splinting had been applied on the battlefield was inspected in the battalion aid station and in subsequent division installations, but it was not disturbed if it was adequate.

The hinged full-ring arm splint was found unsatisfactory in southern Tunisia, and its use was discouraged in Sicily.[25] It was entirely abandoned during 1944. This splint was poorly adapted to fractures of the elbow, and patients were seldom comfortable in it. A few cases of gangrene were reported as the result of pressure of the ring on the blood supply in the axilla.

Fractures of the shoulder, arm, and elbow were best immobilized by placing the arm in a sling and then binding it to the chest, with the elbow in 90° flexion, with another triangular bandage. An axillary pad was always used. Some surgeons preferred to use padded wire splints for these injuries.

The Army half-ring hinged splint remained the most satisfactory transportation splint available during the war in the first echelon of medical care for fractures of the thigh, knee, and upper and middle leg. As time passed, surgeons learned to apply it more competently. For one thing, they learned to use it merely to immobilize the limb, without attempting to reduce the fracture. They also learned to avoid excessive and harmful traction.

In fractures involving the knee and the lower and upper thirds of the femur, the half-ring splint was so bent as to provide for from 20° to 30° knee flexion. At least five muslin slings were used to support the thigh and leg and additional slings were employed for the foot. The litter bar used to secure the splint to the litter added to its effectiveness.

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[25] See footnote 8, p. 361.

Fractures of the lower third of the leg and of the ankle and foot were usually immobilized in wire ladder splints. One splint was applied to the posterior surface of the leg and the plantar surface of the foot, and a second was used as a U or stirrup splint to support the sides of the leg and the foot-piece of the first splint. The splints were well padded and were held in place by bandages.

Transportation splinting after surgery was accomplished with well-padded plaster casts. Circular casts were split or bivalved down to the skin while the patient was still on the operating table. There were no exceptions to this regulation.

The plaster Velpeau was preferred for transportation splinting in fractures of the shoulder, arm, and elbow. The most satisfactory immobilization of compound fractures of the femur was secured by a plaster spica applied to include the intact thigh, with the upper part of the cast extending to just above the iliac crest.

The Tobruk splint required less plaster and less water than other plaster casts, and it was sometimes, of necessity, used when these commodities were in short supply, as not infrequently happened in desert fighting in North Africa. It was occasionally used in extensive soft-tissue wounds of the lower extremity. Otherwise, this splint, which British surgeons favored highly, never won popularity with U.S. surgeons. They used the plaster spica, as just described, except in occasional cases in which there was a concomitant wound of the abdomen. Then the Tobruk splint was useful. This splint was sometimes used in fractures of the knee joint and, less often, in fractures of the leg. More often, a long-leg plaster cast was used for injuries of the leg and a single plaster spica for injuries of the knee joint.

Joint Injuries

The evolution of the management of joint injuries followed the same general pattern as for soft-tissue wounds and fractures. Early in 1944, it was directed that arthrotomy be performed in all joint wounds, to permit wide excision of devitalized cartilage and removal of all foreign bodies. After irrigations with physiologic salt solution, the synovia or capsule was closed, and penicillin solution was instilled. Aspiration of the joint and reinstillation of penicillin were carried out at 24-hour intervals after operation for as long as seemed necessary.

The application of these principles to injuries of the knee joint led to a greatly reduced incidence of infection and much better functional results. A similarly bold approach was recommended in injuries of the hip joint, but it could be applied much less universally. This is an inaccessible joint, and the number of orthopedic surgeons in the theater who had sufficient knowledge of surgery in this area to perform the radical surgery required was always limited.

Resection was practiced in injuries of the knee joint but was not employed in injuries of other joints.

Vascular Injuries

Considerable improvement was effected in the management of wounds of the major vessels of the extremities as the war progressed, but these wounds remained a serious problem throughout.

The use of tourniquets.—Originally, the use of tourniquets was both confused and unsatisfactory. Early in the war, they were used far too frequently and removed far too often. After a tourniquet had been applied by a corpsman on the battlefield, it was examined by the first medical officer who saw the casualty and frequently was removed by this medical officer. If the tourniquet was not removed, it was the policy to loosen it routinely every 30 minutes. In some cases, death occurred from the cumulative effects of the bleeding which ensued each time the tourniquet was loosened. These fatalities usually took place during evacuation by ambulance, on trips lasting several hours, when the medical corpsman loosened the tourniquet every 30 minutes as he had been instructed to do. Many deaths which could have been avoided were thus precipitated because no facilities were at hand to control the hemorrhage which frequently followed the removal of the tourniquet.

Later, the policy was reversed, and, once a tourniquet had been applied, it was not loosened or removed, particularly if the casualty was in shock, until facilities were at hand for the immediate control of hemorrhage and the replacement of blood loss. It was found to be safe, when a large vessel had been damaged, to leave the tourniquet in place for periods of from 4 to 6 hours during cold weather and for somewhat shorter periods in warm weather. Rubber tubing proved more satisfactory than the Army-issue webbing tourniquet.

The study of the use of tourniquets, with particular reference to patients in shock, which was carried out by Maj. Luther H. Wolff, MC, and Capt. Troglier F. Adkins, MC, of the 2d Auxiliary Surgical Group, was the basis of the following regimen, which was in general use when the war ended:

1. Patients with tourniquets in situ should have the highest priority for transportation to the nearest hospital. The emergency medical tag should indicate that a tourniquet is in place. Marking the forehead with a red T was an additional precaution.

2. An effective tourniquet should be placed on an actively bleeding extremity at the earliest possible moment.

3. At the end of about 2 hours, if the patient was not in shock and if all circumstances were favorable, the medical officer might cautiously loosen the tourniquet if facilities were available for immediate control of hemorrhage. If bleeding was negligible or did not recur, the tourniquet might be removed, but the patient was kept under continuous observation, and the tourniquet was left in place for immediate reapplication.

4. On no account should a tourniquet on a patient in shock be removed within 4 to 6 hours of its application unless the blood volume had been at least partly replaced by plasma or whole blood. After this time, the removal or loosening of the tourniquet was a matter of individual judgment. In many instances, sufficient clotting and spasm had occurred by this time to prevent further bleeding.

5. When a tourniquet was in place, the temperature of the affected limb was lowered as much as possible short of actual freezing.

Management.—The first group of vascular injuries managed by lumbar sympathectomy was reported by Maj. James M. Mason III, MC, and Capt. W. Phillip Giddings, MC, from the 2d Auxiliary Surgical Group. Although their results were inconclusive, they thought the procedure had promise. Later, Major Simeone used sympathectomy in a number of vascular injuries of the lower extremity and advocated its prompt performance whenever the patient's condition permitted it. Probably the best results obtained in vascular injuries followed the use of this technique.

Major Simeone also used the Lord-Blakemore Vitallium cuff in a few anastomoses of the popliteal and femoral arteries, but the results were not encouraging.[20] In four cases thus treated at the 33d Field Hospital in December 1943, there were three failures. Other observers had the same experience. As time passed, it became evident that, if the wounds were extensive, vascular repair was likely to be successful only when surgery could be undertaken within 4 to 6 hours of wounding. This criterion could seldom be met.

Vascular injuries were the subject of a special study and a number of formal and informal meetings in Fifth U.S. Army hospitals. All speakers emphasized that any major vascular injury should have priority of care.

At one of these meetings, a patient was presented who had been treated by a French surgeon, for a bleeding popliteal artery, by means of ligation and division of the common femoral artery at the level of the inguinal ligament. The wound in the popliteal area was packed, but the artery was not directly attacked. The result was apparently excellent; in fact, the foot on the injured side was warmer than the normal foot. Major Snyder, nonetheless, felt constrained to warn against this technique until a sufficiently large series of cases had been collected to prove both its safety and its value. No such series was ever reported.

Neurosurgical Injuries

Head injuries.—Some patients with head injuries were sent to field hospitals for resuscitation or evaluation, but surgery was done in this echelon of medical care only if the injury was associated with hypertension; a slow pulse; fixed, dilated pupils; respiratory depression; and deep coma. This group of casualties were to be treated by emergency decompression in field hospitals. All

[20] Medical Department, United States Army. Surgery in World War II. Vascular Surgery, Washington: U.S. Government Printing Office, 1955.

other patients with head injuries only were to be transported to evacuation hospitals.

If a patient with injuries in other parts of the body had to be cared for in a field hospital because of those wounds, the chief of surgery in the field hospital, at his discretion, might call a neurosurgeon forward from an evacuation hospital, usually 5 to 15 miles to the rear, to evaluate the head injury and to operate for it if he thought it was necessary. This system worked very well in the few cases in which it was necessary to invoke it.

In the evacuation hospital, foreign bodies were rem[illegible]t initial wound surgery if they were accessible; that is, if they were on the same side as the injury. If they were on the other side, they were left in situ. Most surgery was performed under local analgesia unless the patient was uncontrollable. Then Pentothal sodium was used.

On one of Colonel Snyder's trips to Anzio, he found, in one hospital, that general surgeons were doing neurosurgery and neurosurgeons were doing chest and abdominal surgery. This was stopped immediately. When neurosurgeons were limited to their specialty, there were enough in the theater to handle all cases. A neurosurgeon was assigned to almost every evacuation hospital, and, if the caseload proved too heavy, a neurosurgical team from the 2d Auxiliary Surgical Group could be attached to the hospital temporarily. Later in the war, when it was found desirable to have two neurosurgeons in each forward evacuation hospital so that there could be round-the-clock neurosurgical care, the neurosurgeon in the rearmost evacuation hospital was moved to the hospital nearest the front.

During 1944, techniques in neurosurgery improved greatly, and Fifth U.S. Army neurosurgeons operated on large series of head injuries with mortality rates far below those reported in World War I. The rates were still high, however, and 19.4 percent of the battle casualty deaths studied in Fifth U.S. Army hospitals in 1944 and 1945 occurred in patients with intracranial injuries (table 12).

Spinal cord injuries.—Injuries of the spine in which the cord was involved also remained a serious problem throughout the campaign in Italy. The percentage of deaths in which spinal or spinal cord injuries were the responsible factor increased from 1.3 percent in the first 3 months of 1944 to 3.9 percent in the January-May period of 1945 (table 12), but the increase was only relative; it was accounted for by the fact that casualties with associated chest and abdominal injuries who had died in the earlier period were now surviving long enough to be hospitalized.

Whenever possible, patients with spinal cord injuries were placed under the care of neurosurgeons, for evaluation and for laminectomy if it was indicated. Since spinal cord injuries were often associated with wounds which rendered the casualties nontransportable, they had to be evacuated to field hospitals, which were not staffed with neurosurgeons.

It was eventually concluded that it was in the best interests of patients with multiple wounds to perform the necessary surgery on the spinal cord injury in field hospitals rather than prolong the timelag and subject them to the further trauma incidental to transportation to an evacuation hospital several hours or several days after surgery for the other wounds. The necessary surgery for intrathoracic and intra-abdominal wounds was completed before the necessary surgery on the spinal wound was performed. Whenever possible, all of the wounds were cared for at the same sitting, though occasionally laminectomy was deferred for a few hours or for a day or two. The work of general surgeons in evaluating these cases and in performing the indicated neurosurgery, including laminectomy, was well done.

Thorough debridement or complete wound excision was just as necessary in intravertebral wounds as in any other wounds. Removal of bone fragments and foreign bodies and excision of devitalized and contaminated tissue were performed as in the usual debridement. The dura was closed.

If there was loss of bladder function in spinal injuries, suprapubic cystostomy was performed routinely before the patient was evacuated from the army area to a base hospital.

Peripheral nerve injuries.—There was general agreement that primary nerve suture was contraindicated in the army area. This was completely reasonable. Most of the wounds had been incurred hours before the patients were first seen, and primary closure of a potentially dirty wound would have been extremely hazardous. For primary nerve suture to be accomplished, a wide, extremely careful wound excision would have been necessary, and even in these circumstances primary wound closure would have greatly increased the hazard of infection, particularly anaerobic infection.

A few surgeons believed that the separated nerve ends should be identified with wire or black silk or should be approximated with a single suture, but the majority believed that nothing at all should be done to the damaged nerve ends at initial wound surgery.

Major Snyder recommended that no surgery for peripheral nerve injuries be done in forward hospitals. This was partly because the results were likely to be poor and partly for other reasons. He had observed one fatal case in which clostridial myositis developed in an extremity when initial wound surgery was deferred until a neurosurgeon was free to suture the nerve primarily. He had also observed a death in Tunisia which could be attributed, at least partly, to the added time consumed in the primary suture of a radial nerve at surgery for a compound comminuted fracture of the humerus. He felt very strongly, in view of these observations, that surgery on peripheral nerve injuries should not be performed in army hospitals.

Thermal Injuries

Burns.—It was consistently held in the North African theater that the correct treatment for burns was the removal of gross debris and the immediate

application of fine-mesh, petrolatum-impregnated gauze overlaid with dry gauze and cotton waste. An occlusive bandage was then used, to achieve slight compression.

These recommendations were set forth in the circular letter issued after the invasion of Sicily.[27] In the Italian campaign, the instructions for limited debridement were changed to include gentle cleansing with cotton, soap, and water, and the excision of gross debris and loose skin. The use of tannic acid had been banned in Africa, and, after the invasion of Sicily, the use of all coagulants was forbidden.

Anesthesia for debridement was discouraged after a patient with only a moderate burn died an anesthetic death during Pentothal sodium anesthesia. Plasma, penicillin, and blood transfusions were used routinely in serious burns.

Cold injury.—The first casualties with cold injury (trenchfoot) observed in Italy passed through a clearing station south of Cassino the first week in November 1943, though not all of them received a correct diagnosis.

After cold injury once appeared, the incidence increased rapidly and over the 6-month period ending 30 April 1944, there were more than 5,700 casualties from this cause in the Fifth U.S. Army. For all practical purposes, these losses were quite as serious as combat losses, for, almost without exception, they occurred in frontline troops, who were always in extremely short supply during the fighting in Italy. During this winter, losses from cold injury amounted to about 7 percent of division strength, and hospital admissions from this cause constituted 9 percent of all admissions for disease.[28]

The lessons of the first winter in Italy were well learned, and, during the second winter, in the 6-month period ending 31 March 1945, there were only 1,572 cases of cold injury. Many of these injuries represented recurrences in men who had suffered from cold trauma during the previous winter. No satisfactory form of treatment was ever developed, and medical officers learned from these recurrences that return to full duty is possible in only a limited number of casualties who have once suffered trauma from cold.

The control of trenchfoot is a command responsibility, and much of the decrease in incidence during the second winter of the war in Italy can be traced to the assumption of this responsibility by commanding officers at all levels. Medical officers, however, participated in the preparation of circular letters on the subject, in general educational efforts, and in other phases of control.

An intensive study of cold injury in Italy was made by Major Simeone. The story of trenchfoot in the Mediterranean theater in the volume on cold injury in this series of histories is based largely on his reports.

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[27] See footnote 8, p. 361.

[28] Medical Department, United States Army. Cold Injury, Ground Type. Washington: U.S. Government Printing Office, 1958.

REGIONAL INJURIES

Maxillofacial Injuries

Maxillofacial wounds were managed by the same general principles throughout the war. The routine included debridement, with the sacrifice of as little tissue as possible; early fixation of the jaw fragments, by elastic traction; provision of an adequate airway, by tracheotomy if necessary; and primary closure of the soft-tissue wound with horsehair or fine silk. Healing without infection was the rule, and no instance of gas bacillus infection was reported in this group of wounds.

The original plan that these wounds should be handled in evacuation hospitals proved sound. The reasoning was that if a good plastic or maxillofacial surgeon did the work there, or supervised the surgery, the results would be better than could be accomplished by a general surgeon without special training in plastic surgery.

In October 1943, Fifth U.S. Army surgeons began to see many maxillofacial injuries caused by a new type of personnel mine, which was weak and exploded underground. The lower extremities and trunk therefore often escaped injury, but the face and hands were burned, and gravel, rubber, leather, and dirt were blasted into the tissues and caused numerous and often severe lacerating and penetrating wounds.

The mortality rate in maxillofacial wounds was low. There were only 6 deaths from this cause in 1,450 battle casualty deaths studied in Fifth U.S. Army hospitals (table 12).

Wounds of the Neck

The cardinal points in the management of wounds of the neck were as follows:

1. Debridement of all involved structures. Multiple involvement was the rule because of the anatomy of the area.

2. Prompt identification of wounds of the carotid artery, with early, adequate blood replacement combined with oxygen therapy to combat cerebral ischemia.

3. Identification and attempted repair of wounds of the cervical esophagus. Primary closure was frequently impossible. These wounds were comparatively uncommon.

4. Removal of foreign bodies from, and drainage of, the retropharyngeal and retroesophageal spaces.

5. Resuscitative and supportive therapy according to the indications.

Cervical wounds were the chief cause of death in 26 of the 1,450 battle casualty deaths studied from Fifth U.S. Army hospitals (table 12). Of the 11 patients in this group who died of shock, 4 had lacerations of the carotid artery, and 6 had lacerations of the jugular or the subclavian vein. Four other

patients in the 1,450 fatal cases also had lacerations of the carotid artery with cerebral ischemia, but the vascular injury was not the immediate cause of death.

Wounds of the Chest

Major Snyder's contacts with combat-incurred wounds of the chest followed immediately upon his observations of these injuries in England (p. 335). When the 77th Evacuation Hospital landed in North Africa and took over the hospitals in Oran, many of the casualties had received little or no care. In particular, wounds of the chest had not been debrided, sucking wounds had not been closed, and hemothoraxes had not been aspirated. Although some of these hemothoraxes became infected, none of the patients developed empyema because daily aspirations of the chest were instituted and sulfonamide therapy was employed systemically.

In Tunisia and Sicily, the correct management of chest wounds was often difficult because of the lack of proper anesthetic and other equipment. Maj. Philip F. Partington, MC, prepared needles with flutter valve attachments made from condoms or Penrose drains, and the improvised equipment proved very satisfactory in the management of tension pneumothorax in casualties who had to be evacuated. It was learned early in the war that water seal bottles were not only unsatisfactory but were also dangerous to use during evacuation, whether they were connected to needles or catheters, for the drainage of air or blood from the pleura.

It was a strict rule that no patient be evacuated with an intercostal catheter in place. If he had to be moved, water seal drainage was replaced by flutter valve equipment. A number of surgeons abandoned catheter drainage after thoracotomy except when oozing was unusually profuse or there was a continuing air leak from the lung, because of the difficulty in maintaining the correct use of water seal bottles. Most of the time, the casualty was on a cot only a few inches above the floor, and, whenever an uninformed person picked up the water seal bottle to see how much drainage had occurred, the fluid ran back into the chest. It was found that fewer aspirations of the chest were necessary when closure was accomplished without intercostal drainage than were necessary after removal of the intercostal catheter in cases which had been drained.

The circular letter, published after the invasion of Sicily,[29] gave the following directions for the management of wounds of the chest:

1. Shock, continuing hemorrhage from the chest wall, tension pneumothorax, and open sucking wounds should be treated by the necessary emergency measures at the battalion aid station or the collecting or clearing stations.

2. Casualties suffering from dyspnea and those in continued shock or verging on shock should be transferred to a field hospital. Casualties with sucking

[29] See footnote 8, p. 361.

chest wounds and persistent hemorrhage from the chest wall should also be treated in field hospitals.

3. Transportable casualties should be treated in evacuation hospitals. As it worked out, the majority of casualties with wounds of the chest were treated in evacuation hospitals because they were safely transportable to them.

This circular letter set forth the management of the wound at initial wound surgery as follows:

1. Sucking chest wounds should be debrided.

2. Loose bone fragments, bits of clothing, and accessible foreign bodies should be removed.

3. Wound closure should be accomplished.

Thoracotomy.—If retained foreign bodies were present which might require removal by formal thoracotomy, and initial wound surgery had been confined to the chest wall, the patient was transferred to an evacuation hospital as soon as respiratory equilibrium had been accomplished.

In January 1944, it was directed that thoracotomy, through the wound or through an elective incision, might be done in field hospitals on the indication of sucking chest wounds; continued intrathoracic hemorrhage; thoracoabdominal wounds; and large bronchopleural fistulas not controlled by conservative measures. If the wound had to be enlarged after debridement to permit satisfactory examination of the depths, removal of readily accessible foreign bodies was permitted. It was also directed at this time that, if possible, large foreign bodies be removed from the lung at initial wound surgery in evacuation hospitals if the patient was unlikely to reach a base hospital within 10 days.

Hemothorax.—During their preliminary observations in England, Major Snyder and his associates had been warned by Mr. Tudor Edwards that the management of hemothoraxes would be one of their major tasks as thoracic surgeons. British surgeons taught that aspiration of a hemothorax should be performed at least once a day, or, in the early stages, even oftener. Massive clotted hemothoraxes might occasionally be encountered in which thoracotomy would be necessary in a forward hospital.

Air replacement, which was recommended after aspiration in War Department Technical Manual 8-210, published in 1942,[30] had been entirely abandoned by British surgeons. Their reasoning was (1) the lung reexpanded rapidly and therefore hemorrhage was unlikely to occur, (2) bleeding was less likely to recur if the lung was fully expanded, and (3) if air were injected after aspiration of blood and empyema should subsequently develop, it would be total empyema and most difficult to manage.

The large number of casualties with hemothorax encountered in the hospitals at Oran had received little or no treatment, as has already been noted, and some of the wounds were already infected. The British teachings were promptly put into effect, with remarkably good results, and thereafter were

[30] War Department Technical Manual 8-210, Guides to Therapy for Medical Officers, 20 Mar. 1942.

employed regularly. Even late in the war, however, it was sometimes necessary to warn competent chest surgeons that air replacement must not be employed after aspiration of the chest.

Major Snyder, after his observations in England, came to believe quite strongly that if a massive clotted hemothorax was encountered in a forward hospital it should be evacuated by thoracotomy. The surgeon, in such cases, had to be prepared to stop bleeding from a large pulmonary vessel. The development of large clotted hemothoraxes which were not aspirated early was usually to be explained by bleeding which had occurred so rapidly that the respiratory movements of the lung and chest wall could not defibrinate the blood rapidly enough to prevent clotting. This frequently happened when large pulmonary vessels were injured. When the hemothorax filled with blood, the lung collapsed, and bleeding from the damaged pulmonary vessel ceased. When the clotted blood was evacuated, hemorrhage might again ensue and the surgeon must be prepared for the contingency.

Evacuation of the hemothorax by merely opening the chest and scooping out the clotted blood with the hand differed from the decortication necessary in base hospitals when a clotted hemothorax had persisted for from 3 to 6 weeks after injury. Even then, the entire mass of clotted blood often peeled readily from both the visceral and the parietal surface, thus permitting immediate reexpansion of the lung.

Wet lung.—The condition which came to be known as wet lung was frequently encountered. It was a collection of mucus and blood in the tracheobronchial tree which the patient could not or did not cough up because of painful wounds of the chest wall, hemothorax, pneumothorax, or inhibition of the cough reflex because of coma. Wet lung was associated with bronchospasm, and bronchorrhea was often extreme.

It was found that this condition could be readily controlled by procaine hydrochloride block of the affected intercostal muscles or by paravertebral block of the two segments above and the two below the wound. The patient received a small dose of morphine and atropine before the procedure, and the atropine was repeated at 4-hour intervals afterward if necessary. The nerve block frequently had to be supplemented by endotracheal catheter suction and occasionally by bronchoscopic aspiration.

This treatment often transformed a severely ill patient, with bronchospasm, dyspnea, and cyanosis, into a person who was quite comfortable and who could easily expectorate the mucus and other material blocking the tracheobronchial tree. If the patient had been in shock, the change was particularly striking. It was seldom necessary to repeat the procaine block.

Some surgeons regarded wet lung as potentially so dangerous that they advocated the performance of procaine block in all patients with chest injuries before they were evacuated from the clearing station to an evacuation hospital. Most surgeons did not regard the procedure as practical in the clearing station or as necessary in all chest wounds.

Final principles of management.—It was the consensus in the Mediterranean theater at the end of the war that wounds of the chest should be managed according to the following principles:

1. Of the casualties with wounds of the chest who do not die on the battlefield, very few will die later if fully trained surgeons can care for them in properly equipped hospitals. A surgeon experienced in both thoracic and abdominal surgery is best qualified to treat the severe wounds of the chest encountered in forward hospitals.

2. Severe wounds of the chest require first priority management. This means that they must have surgical care promptly, in the farthest forward hospital.

3. Prompt, well-directed resuscitative measures are essential, especially if there are complicating abdominal wounds.

4. Anesthesiologists well trained in endotracheal anesthesia are essential in the correct management of wounds of the chest. Endotracheal anesthesia administered through a closed apparatus capable of positive pressure gives the best results in perforating and penetrating wounds.

5. Open chest wounds should be occluded with gauze and adhesive strapping before the patient is evacuated to a hospital equipped and staffed for definitive chest surgery.

6. Patients with continuing intrathoracic hemorrhage and large bronchial fistulas require immediate thoracotomy.

7. Hemothorax should be managed by prompt, repeated aspiration, without air replacement. This technique is not associated with any risk of hemorrhage.

8. The only treatment required in most uncomplicated wounds of the chest is debridement of the wound of the chest wall.

9. Large pneumothoraxes are managed by early aspiration, followed by continuous aspiration by a catheter connected with a water seal if the pneumothorax recurs because of a continuing leak of air from the lung or a bronchus.

10. There are clear-cut indications for thoracotomy by way of the chest wound. Indications for performing it by way of a separate incision are as follows: (1) Intrathoracic hemorrhage; (2) large bronchial fistulas; (3) foreign bodies in the pleural cavity; (4) large sucking wounds which could be explored with little or no extension of the traumatic wound; (5) massive clotted hemothorax; (6) cardiac tamponade; (7) wounds of the esophagus, diagnosed or merely suspected; (8) thoracoabdominal wounds, diagnosed or merely suspected.

11. At the end of the operation, it is wise to carry out certain supplementary procedures. The pleura should be well irrigated, to evacuate all blood, foreign bodies, and air. The lung should be completely expanded by inflating it out to the chest wall whenever the pleura has been opened traumatically or surgically. Bronchoscopic aspiration of blood and mucus from the trachea, main stem bronchus, and lower bronchi should be employed at the end

of the operation, as well as during it, if less radical procedures fail to clear the tracheobronchial tree. This measure is not necessary if tracheal suction by catheter has been successful.

12. Intercostal nerve block is an important phase of adjunct therapy. It relieves pain, and thus promotes deeper breathing and facilitates expulsion, by cough, of blood and mucus in the tracheobronchial tree.

13. Replacement therapy is most important. Whole blood is preferred to other fluids, and autotransfusion of intrapleural blood should be used whenever this is practical. The blood should be given slowly after the systolic pressure has reached 80 mm. Hg, and no more should be used than is necessary to achieve adequate resuscitation.

14. Sulfonamide or pencillin therapy should be instituted as soon as possible and continued until the pleura is free of air and fluid and any pulmonary consolidation present has resolved.

15. When the casualty has sustained multiple wounds, surgery of the chest wounds is usually done first. Most thoracoabdominal wounds are best handled by the thoracic approach (p. 438). If the wounds must be managed separately, the chest wound is cared for first.

Mortality rates.—During 1944, there was general improvement in the management of chest injuries. There were still unwise thoracotomies. There was still a reluctance to perform aspiration often enough in hemothorax, and there were occasional instances in which either more surgery or less surgery should have been done in the field hospital. Many surgeons, however, had acquired a knowledge of, or had improved their previous knowledge of, preoperative and postoperative management as well as operative techniques. The most striking improvements occurred in anesthesia; preoperative management; the selection of cases for thoracotomy; the use of the thoracic approach in thoracoabdominal wounds; evacuation and cleansing of the pleura; and complete reexpansion of the lung.

Nonetheless, in spite of these improvements, thoracic, thoracoabdominal, and abdominal trauma contributed most heavily to deaths in the Fifth U.S. Army. In the 1,450 battle casualty deaths studied from Army hospitals, these categories (table 12) accounted for more than half of the fatalities (thoracic, 9.2 percent; thoracoabdominal, 13.9 percent; combined thoracic and abdominal, 3.7 percent; and abdominopelvic, 25.4 percent).

Case histories.—Major Snyder's official diary was filled with illustrations of chest injuries well and ingeniously handled or of interest for other reasons, as the following histories indicate.

1. A casualty who was observed in an evacuation hospital in Sicily, when the caseload was unusually heavy, taught an extremely valuable lesson. The history was unknown; he had been found on a mountainside and brought in in a semicomatose state. He was in the shock ward, propped up on a litter, gasping for breath, and practically comatose. His respiration had a peculiar, grunting sound. Roentgenograms of the skull had shown an apparent small fissure fracture, though there was no contusion or abrasion of the scalp. When Colonel Churchill and Major Snyder examined him, there were three significant

findings. There was dullness over the entire left hemithorax, the cardiac dullness was on the right, and the trachea was displaced to the right. The man died almost as soon as aspiration of the chest had been started. At post mortem, the left pleural cavity was found filled with 4,500 cc. of blood, caused by a partial laceration of an intercostal artery which was caused, in turn, by a broken rib. In short, this man had died of intrathoracic hemorrhage from a simple, undiagnosed, overlooked rib fracture.

2. Another patient observed in an evacuation hospital had a sucking chest wound which had been treated in the field hospital by debridement, sucking out of the pleura, and pleural closure. The wound was packed, without intercostal drainage. A roentgenogram taken before this operation had shown partial collapse of the lung and hemopneumothorax. When the patient was observed 7 days later, he still had a partial collapse of the lung, and the hemothorax had become massive and clotted. Decortication was necessary later. In this case, it would have been better to have evacuated the pleura completely at the first operation and instituted intercostal drainage or to have let the patient alone until he could be treated definitely in an evacuation hospital.

3. In a case observed at the 56th Evacuation Hospital, 475 cc. of blood had been removed from the pericardium by aspiration. It continued to reaccumulate, and exploration revealed that it was oozing from a tiny leak caused by a tangential wound of the right ventricle. Repair was performed 12 hours after injury. The patient's postoperative condition was excellent, but he had an associated division of the cervical spinal cord from a bullet which had proceeded upward and posteriorly.

4. A patient observed at the 38th Evacuation Hospital had compound fractures of both legs caused by a mine explosion. Although he arrived in reasonably good condition, he became dyspneic shortly afterward and died within 24 hours. At autopsy, the wounds of the legs were found in satisfactory condition, and all other findings were negative except for the lungs. They floated in formalin solution; but, on section, diffuse hemorrhages were found throughout the pulmonary tissue, as pronounced near the hilum as at the periphery. There was considerable fluid. Ecchymosis was diffuse, and there were no large hematomas, but the hemorrhage appeared to be interstitial. The lungs were dark bluish red throughout.

No case of this kind had been observed previously by the surgical consultant, but a number were seen later. A number were also studied by Lt. Col. Tracy B. Mallory, who regarded the condition as a possible combination of fat embolism and blast injury.

Thoracoabdominal Injuries

Major Snyder's convictions about the management of thoracoabdominal wounds came from his early observation and care of a number of these injuries. In particular, he believed very strongly that the best approach to them was through the chest wall.

The first of these patients, a Ranger, was operated on in Tunisia, in March 1943. Using the transthoracic approach, Major Snyder was able to remove the spleen, suture several lacerations of the jejunum and colon, and then suture the diaphragm and chest wall. The operation was performed with considerable difficulty because neither oxygen nor positive pressure anesthesia was available. The anesthesiologist, however, overcame these difficulties with considerable ingenuity. He had some endotracheal tubes and a rebreathing bag. He took a Y-tube from a stethoscope and hooked the lower limb to an endotracheal

tube. One of the upper limbs was hooked to a tube leading to a Flagg can of ether and the other to the rebreathing bag. The bag was inflated by blowing it up by mouth. When it was necessary to expand the lung, once in the middle of the operation and again as the chest was closed, the tube to the ether can was clamped, and manual pressure was made on the bag.

The patient withstood surgery well in spite of these unpropitious circumstances, and he was evacuated the following day, as a matter of necessity, for a distance of 50 miles. Five days later, he was sitting up in bed and on a general diet. His recovery seemed assured, but postoperative care was poor, because of the rush of casualties, and he died of profound anemia. He had had no blood at all and very little care of any kind. With average attention, he would undoubtedly have lived.

Another equally instructive case was observed at autopsy in Italy, at the 38th Evacuation Hospital. This patient had a sucking wound of the chest and a laceration of the diaphragm, through which the omentum had herniated. The laceration of the diaphragm had been repaired in a field hospital 3 days before. The intention was to perform laparotomy as soon as the patient had reacted from shock. The plan could not be carried out because the hospital was heavily shelled and all the patients had to be evacuated at once to the 38th Evacuation Hospital. When laparotomy was performed there, 24 hours after the first operation, some blood was found in the peritoneum, but no other injury was evident. The next day, 900 cc. of blood was aspirated from the left chest; the chest wound seemed clean. Twenty-four hours later, a large swelling was found extending from the chest wound up the left chest posteriorly and into the axillary area. The pulse was very rapid, and the temperature was 108° F. (42.2° C.). Death occurred before the sutures closing the chest wound could be removed.

At autopsy, the latissimus dorsi above and below the wound was three times the normal thickness, dark red, and full of gas bubbles. No infection was evident in the subcutaneous tissues. Feces were escaping through the chest wound from a laceration of the splenic flexure of the colon on the retroperitoneal aspect.

Further investigation showed that the chest wound had been excised and the skin wound left open, according to standard practice. The surgical incision made over the rib above the skin wound had been tightly closed.

In this case, just as was done in the first case, all the necessary surgery could have been accomplished through the diaphragm, and exploration through it would have revealed the wound of the colon.

The management of a thoracoabdominal wound was governed by the position of the wound as follows:[31]

Principles of management of left-sided wounds.—Failure to recognize left-sided thoracoabdominal wounds resulted in a number of fatalities. The

[31] Snyder, H. E.: The Management of Intrathoracic and Thoracoabdominal Wounds in the Combat Zone. Ann. Surg. 122: 333–357, September 1945.

possibility that the missile had traversed the diaphragm had to be considered in every chest and abdominal wound. Exploratory thoracotomy was often indicated as a diagnostic measure. Often, slight enlargement of the debrided wound permitted exploration sufficient to determine the presence or absence of a wound of the diaphragm.

When a thoracotomy through a large incision was necessary, it was best to make it separate from the wound. Sometimes, however, the wound was at the site of the elective incision, and thoracotomy through the wound was then necessary.

Most surgeons familiar with thoracic surgery preferred the thoracic approach to all thoracoabdominal wounds, even if laparotomy had to be done also. The diaphragmatic wound was enlarged through the open chest, the enlargement being sufficient for exploration and repair of all accessible abdominal structures. In the great majority of cases, all necessary abdominal procedures could be carried out through the thoracotomy incision. Splenectomy, repair of wounds of the stomach, and mobilization of the splenic flexure are much more easily accomplished through this approach than by celiotomy. Almost the entire small intestine, the transverse and descending colon, and the kidney are usually accessible. Wounds of the retroperitoneal portion of the splenic flexure, the spleen, and the posterior gastric surface were seldom missed by a thoracic approach but were frequently overlooked at celiotomy.

Objection was sometimes raised to dealing with wounds of the colon and small intestine through the chest, on the ground that infection of the pleural cavity might result. This was not a valid objection. Whenever a wound of the diaphragm existed, contents of perforated hollow organs beneath the diaphragm were sucked into the pleural cavity before operation. Thoracotomy made possible the thorough evacuation of gastric and intestinal contents which might be present in the pleural cavity. It was believed that in left thoracoabdominal wounds it was well to accomplish all surgery in the left upper quadrant of the abdomen through the thoracic approach even when it was known that laparotomy would also have to be done.

The site of elective thoracotomy in thoracoabdominal wounds was usually the 9th or 10th rib bed or interspace. Many of these wounds involved the 8th, 9th, 10th, or 11th rib or interspaces. An incision in the 9th to 11th costal beds or interspaces might be extended forward through the abdominal wall to facilitate necessary procedures within the abdomen. It was desirable to extend the incision for 1 or 2 inches into the abdominal wall if this procedure would eliminate the necessity for a separate large abdominal incision. Small muscle-splitting incisions were indicated for subdiaphragmatic drainage or exteriorization of mobilized loops of the colon.

Wounds and incisions of the diaphragm were repaired with interrupted sutures of fine cotton or silk. The diaphragmatic edges were imbricated, or the first row of stitches was inverted toward the abdomen with the second

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row. Catgut was not satisfactory for this purpose; a number of wound disruptions were reported when it was used.

It was not the custom to crush the phrenic nerve as a routine measure in diaphragmatic wounds, though it might be indicated if the defect to be repaired was very large.

Other steps of the procedure included removal of foreign bodies from the pleura or lung; suture of the pleura over lacerations of the lung; irrigation of the pleura with physiologic salt solution; and complete reexpansion of the lung as the wound in the chest wall was closed.

Thoracotomy incisions were closed with cotton or silk, except occasionally when the time factor justified the use of catgut. As a rule, the time factor had to be considered because of a backlog of other seriously wounded patients; it seldom had to be considered because of the necessity for rapid termination of the operation due to the patient's condition.

Penicillin therapy, both local and systemic, was always indicated in thoracoabdominal wounds. Some surgeons preferred to use sulfanilamide locally in the peritoneum.

Principles of management of right-sided wounds.—Thoracotomy was indicated in almost every wound of the right diaphragm, regardless of the size of the missile or the possible size of the wound in the liver. Hemorrhage or escape of bile was often profuse.

Thoracotomy was done, and the wound in the diaphragm was enlarged to permit institution of subdiaphragmatic drainage of the hepatic wound. Drainage was accomplished by large Penrose drains; the gauze protruding from the inner end was packed loosely into the liver wound. Fatal hemorrhage was reported in wounds of the liver which had not been packed or sutured. The drains were invariably brought out subdiaphragmatically, through a separate subcostal incision or an incision in the loin, never across the pleural space.

Right thoracotomy incisions from the 9th to the 11th interspace could be extended into the anterior abdominal wall, to permit examination of the liver and hepatic flexure, the right half of the transverse colon, the duodenum, and the head of the pancreas. The need for a separate celiotomy incision was often thus eliminated. Wounds of the posterior diaphragm could also be enlarged to permit nephrectomy, suture of the kidney, or establishment of drainage of the perinephric area through a stab incision in the loin.

Suture of the right diaphragm, as of the left, had to be done with the greatest care. The use of interrupted sutures of fine silk or cotton was mandatory. Biliary-pleural fistulas were repeatedly observed when catgut was used. Suture of the diaphragm to the chest wall was avoided, as was drainage of the liver through the diaphragm and the chest wall.

As in wounds of the left side of the diaphragm, it was always best to complete the chest surgery before making a laparotomy incision.

Combined thoracic and abdominal wounds.—When chest and abdominal wounds were present in the same patient without a communication through

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Combined thoracic and abdominal wounds.—When chest and abdominal wounds were present in the same patient without a communication through

a wound in the diaphragm, transdiaphragmatic surgery was not recommended. It would have violated surgical principles because it would have subjected the intact pleura to contamination. Contamination is always present when the diaphragm is perforated together with perforation of a hollow viscus.

When chest and abdominal wounds occurred in the same casualty, primary care of the intrathoracic wound was the more important unless profuse intra-abdominal hemorrhage or massive evisceration made laparotomy an urgent primary procedure.

Abdominal Injuries

By 1944, certain fundamental principles for the management of abdominal injuries had been established in the Mediterranean theater and were being followed routinely in Fifth U.S. Army hospitals. The importance of rapid resuscitation and early operation was generally appreciated. Almost every patient with an abdominal wound was given the chance which surgery offered; only casualties who were moribund on admission to the hospital did not reach the operating table. The number of surgeons who did excellent abdominal surgery was also steadily increasing.

When the United States entered World War II, the concept was that resuscitation from shock must be accomplished before surgery was undertaken. Generally speaking, this was correct. But it was promptly learned in North Africa and Sicily that this rule had its exceptions and that if some casualties were to survive they must be operated on before the blood pressure reached a satisfactory level. Major Snyder was particularly impressed with a fatal case observed on one of his first hospital tours in Italy; the patient was repeatedly scheduled for surgery, and surgery was repeatedly deferred because his blood pressure could not be elevated above 50 mm. Hg even with large amounts of blood. The surgeons in field and evacuation hospitals were always advised that these patients, without more delay, should be taken to the operating room and explored. The explanation in such cases was very frequently that massive hemorrhage was continuing or that massive contamination of the peritoneal cavity had occurred.

Captain Lalich, even before he had the laboratory proof of the essential role of blood loss in shock, had formulated this rule; if a patient did not respond to 1,000 cc. of blood given over a period of approximately 10 minutes, preparations should be made for exploration. While these preparations were being made, there would be time for another 500 cc. of blood to be given, and the transfusion should be kept running during surgery. In effect, surgery was thus made a part of the resuscitative procedure, and many lives were saved as a result.

Not the least important of the reasons for the improvement in the results in abdominal injuries was the provision, instituted soon after the landings in Sicily, for holding patients who had undergone laparotomy for from 10 to 14 days afterward. There was no surer way of increasing the mortality of

abdominal injuries than by evacuating patients immediately after surgery, as had been the original practice. After the 24th General Hospital was set up in Florence in the fall of 1944, it became the practice to hold all patients with abdominal wounds in the field hospitals in which they had been operated on until they could be evacuated directly to base hospitals. This practice not only eliminated the usual stopover at an evacuation hospital but also made it possible to proceed more promptly with closure of the colostomy.

Management.—Wounds of the stomach and small intestine were treated by repair whenever this was possible; otherwise, resection was done, with primary anastomosis. In these wounds, as in all other perforating wounds of hollow viscera, the subfascial space was drained with a Penrose drain or rubber tubing, and the skin was not sutured except for the closure effected by retention sutures. The practice of exteriorizing wounds of the small bowel was discouraged. Small wounds of the cecum and ascending colon were also treated by primary suture and were not exteriorized.

A few surgeons thought that, if circumferential damage was minimal, small wounds of the left colon could be treated by primary suture; cecostomy was always performed in such cases.

All sizable wounds of the colon and all wounds in which there was segmental interruption of the blood supply were treated by exteriorization of the affected part at initial wound surgery. If the wound was in the rectum or the rectosigmoid, proximal colostomy was performed. Wounds in the antimesenteric border of the colon were usually exteriorized as tangential loop colostomies. Wounds in the mesenteric border were managed by complete division of the lumen of the bowel and exteriorization of both limbs as a spur colostomy. The limbs of the colostomy were so placed that they tended to fall together, but they were not usually sutured. In some cases, the divided ends of the bowel were separated by an intervening bridge of skin. The importance of adequate mobilization of the segment of the colon to be exteriorized was increasingly appreciated, and retracted colostomy stumps were seldom observed.

Some wounds of the colon had to be managed by right colectomy, with an ileotransverse colostomy of the spur type. Surgeons were instructed to bring the terminal ileum and transverse colon out together through a separate surgical incision and suture them together to form a long spur. The spur was usually crushed early in the postoperative period, preferably by the fourth postoperative day.

Exteriorization was always accomplished through an incision separate from the main surgical incision. At the 15th Evacuation Hospital, on one of his visits, Colonel Snyder observed a number of patients with wounds of the colon whom he had seen earlier, at the 33d Field Hospital. In all of these cases, exteriorization of the colon had been performed through the laparotomy incision, and all the wounds were breaking down. It was not long before all forward surgeons had been instructed to bring the colon out through a separate stab wound.

Originally, petrolatum-impregnated gauze had been used to hold the skin edges open. It did not prove very satisfactory; the subcutaneous fat was widely separated, and the gauze was very difficult to remove. It was suggested that rubber tissue drainage of the fatty layer be substituted for this type of gauze drainage. The practice soon became standard and made it possible to close the skin completely without danger.

Postoperative measures.—The daily administration of from 500 to 750 cc. of plasma was standard practice in the immediate postoperative period. The Levin tube or Wangensteen suction was used for from 3 to 7 days after operation. Otherwise, the postoperative regimen followed the usual plan.

Wound dehiscence.—The incidence of wound dehiscence was always distressingly high in abdominal wounds. The best results were secured in closure of the laparotomy incision by the use of fine catgut for the peritoneum and interrupted sutures of fine silk or cotton for the fascia. Retention sutures of heavy silk or wire, tied loosely, were always used. They were so placed as to include the fascia, or the fascia and muscle, or all layers of the abdominal wall.

Mortality rates.—Intra-abdominal wounds accounted for more deaths in the Mediterranean theater than any other group of wounds. They (abdominopelvic wounds) were responsible for 368 (25.4 percent) of the 1,450 battle casualty deaths studied in Fifth U.S. Army hospitals (table 12). The principal wound in 40 other deaths was also intra-abdominal, but this injury was not the principal cause of fatality in these cases.

Hand Injuries

The management of hand injuries in the forward area early in the war was generally poor, and improvement was slower in coming than it was in most other injuries.[32] In fact, little was done to standardize the management of these injuries until the second winter of the war, when the troops were halted on the Gothic Line. At this time, the 24th General Hospital was located in Florence, and the Army evacuation hospitals were chiefly located north of this city, with a few to the west. With the lull in combat, it was possible for Maj. Harvey S. Allen to make a tour of all of these hospitals, lecturing on and demonstrating the correct care of hand injuries.

The basis of management was adequate debridement, with, at the same time, sacrifice of as little tissue as possible. Primary nerve suture, as already mentioned, was not permitted in army hospitals, and both primary and secondary tendon suture was also forbidden. When excisional surgery had been concluded, the exposed structures were covered, contrary to the usual rule that wounds should be left open.

The hand was put up in the position of function, splintage being accomplished by any of several methods. One splint, the so-called boxing glove splint,

[32] Medical Department, United States Army. Surgery in World War II. Hand Surgery. Washington: U.S. Government Printing Office, 1955.

was developed by Colonel Cox, Chief of Surgery, 24th General Hospital. Another splint was developed by Lt. Col. Michael L. Mason and Major Allen. These splints were constructed by Ordnance personnel and were supplied on request to surgeons in forward areas. Wire ladder or plywood splints were probably more generally used than any other kind.

When the boxing glove splint was used, the hand was put up in the position of function, in a huge compression dressing which was held in place by a thin layer of plaster-of-paris bandage extending to the upper forearm. The fingertips and the tip of the thumb were usually left exposed.

The Mason-Allen splints were constructed of aluminum. Their distinctive feature was a half sphere or half ball over which the palm was placed. These splints could be used on either hand and proved quite satisfactory. Since the war, they have been available from commercial sources.

COMPLICATIONS

The incidence of clostridial myositis (gas gangrene) was high in the Sicilian campaign, and its disastrous potentialities were promptly recognized. Captain Jergesen, of the 2d Auxiliary Surgical Group, was particularly aroused by the problem, and many of the valuable suggestions in Circular Letter No. 2, Office of the Surgeon, Headquarters, II Corps,[33] were made by him.

The incidence of this complication continued high in the early fighting in Italy, and when Major Snyder assumed his duties as consultant for the Fifth U.S. Army in September 1943 he found Colonel Martin, Surgeon, Fifth U.S. Army, seriously alarmed about it. Medical Circular No. 4, Office of the Surgeon, Headquarters, Fifth U.S. Army,[34] was immediately prepared. It described in detail the etiologic factors and prophylactic and therapeutic methods of management. In all visits to hospitals, Major Snyder presented this subject, and it was also the subject of one of the first of the Fifth U.S. Army Medical Conferences (p. 366).

By the end of October 1943, Colonel Churchill had taken steps to initiate an intensive study of clostridial myositis and of vascular injuries in general in Fifth U.S. Army hospitals (p. 428). The work was in charge of Captain Jergesen and Major Simeone. In December, arrangements were made with Colonel Cornell, head of the 15th Medical General Laboratory, to furnish a mobile laboratory with a clinical pathologist and two bacteriologists to assist in the investigation.

This investigation and the intensive educational efforts made throughout the Fifth U.S. Army hospitals resulted in a prompt reduction in the incidence of clostridial myositis. Good surgery, based on more liberal debridement of wounds in which this complication was a possibility, accounted for much of the improvement. Established infection was also better managed, by the liberal

[33] See footnote 5, p. 361.
[34] See footnote 6, p. 361.

use of blood, serotherapy, and the administration of penicillin. Before the use of penicillin became routine in all severely wounded battle casualties, the incidence of clostridial myositis had been reduced to five or six cases per thousand. After its use became routine, there were only nine instances of gas gangrene in the last 4 months of 1944, during which 15,553 battle casualties were admitted to Fifth U.S. Army hospitals.

Clinical considerations.—The British had had an extensive experience with clostridial myositis before the United States entered the war, and Major Snyder was able to discuss it in detail with Maj. J. D. MacLennan, RAMC, whose special assignment was investigation of anaerobic infections in the British Eighth Army. His studies included both the laboratory and the clinical aspects.

Major MacLennan emphasized the following clinical features of infection with *Clostridium welchii perfringens:*

1. The onset is rapid. He had observed the infection in one casualty only 5 hours after wounding.
2. Pain is the first complaint.
3. Early in the course of the infection, the casualty is bright, alert, but extremely apprehensive.
4. The fever is high and the patient seems very ill.
5. The skin is pale and marbled, and there is some edema. Gas is comparatively scanty.
6. The muscle is at first pink, then pale and mushy, then reddish purple, and finally slate blue.
7. When the infection is pure, the odor is sweetish and only mildly foul.

In *Clostridium novyi oedematiens* infections, the following clinical features are notable:

1. The onset is slower, the infection seldom being seen earlier than 8 hours after wounding.
2. There is little or no pain, the first complaint usually being a sense of heaviness in the affected part.
3. The patient is apathetic.
4. The fever is not high.
5. The skin is discolored. Edema is pronounced, and as a result little gas is evident.
6. The muscle changes rapidly from pale pink to dark brown and then to black. The wound drips fluid, and the tissues seem full of fluid.
7. The odor may be sweetish and foul but is seldom pronounced.

Major MacLennan also discussed other anaerobic infections as follows:

1. In anaerobic streptococcic cellulitis, the muscles are brick red, moderately swollen, and edematous. The oder is foul. A smear from the muscle shows many leukocytes and small, shortchain streptococci, with only a few clostridia, in contrast to *Cl. welchii* infections, in which there are few pus cells and many clostridia.

Treatment consists of liberal incision into the muscle and local sulfanilamide therapy.

2. In anaerobic cellulitis, the patient is not very ill. Pain is not marked. The odor is foul. Gas is profuse, but the infection is limited to the fascial planes and muscle devitalized by the wounding agent.

Treatment consists of excision of dead tissue, adequate drainage of fascial planes, and systemic and local sulfonamide therapy.

All of this information was incorporated in the extensive discussion of anaerobic infections contained in Medical Circular No. 9, Office of the Surgeon, Headquarters, Fifth U.S. Army.[35]

Early in the war, two deaths from pulmonary embolism occurred in the 94th Evacuation Hospital after amputation for gas gangrene. The technique employed thereafter in this hospital, that the femoral vein be ligated distal to the profunda in all amputations on this indication, later became routine in all army hospitals.

Special precautions in the evacuation of patients with vascular injuries also became routine, as it soon became evident that anaerobic infection frequently developed in these patients.

Thrombosis and Embolism

In November 1943, following several deaths from pulmonary embolism, all confirmed at post mortem, it became the policy to watch patients closely for the development of phlebothrombosis. The wisdom of this policy was soon evident in three cases in which thrombosis of the femoral vein was suspected. All were studied by venography. One venogram showed only a saphenous thrombosis. The others showed thrombi in the femoral vein, probably ascending into the iliac vein. Phlebotomy and thrombectomy were done in both cases, with immediate symptomatic relief and ultimate recovery, though fever did not subside for several days and swelling persisted even longer.

The following spring, Major Lyons performed numerous venous ligations for phlebothrombosis, which in some instances was associated with thrombophlebitis. In his experience, there was successively less edema with the performance of common iliac ligation, external iliac ligation, superficial femoral ligation, and common femoral ligation. It was his opinion that the tremendous edema observed in some fractures of the femur could be explained by thrombophlebitis.

Anuria and Nephropathy

Anuria and oliguria were frequently encountered in severely wounded men. Part of it could be explained as a physiologic response to wounding, but by January 1944 the incidence had increased to a considerable degree, and some other explanation was necessary.

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[35] See footnote 7, p. 361.

One theory was that sulfonamide therapy might be responsible, and special precautions for its use were detailed in a medical circular from the office of the Fifth U.S. Army surgeon in January 1944.[36] After attention had been called to the fact that most cases of anuria to date had occurred in patients who had received sulfadiazine intravenously in 5-gm. doses, the following precautions were laid down:

1. Not more than 10 gm. of sulfanilamide powder should be used intraperitoneally and in associated wounds at the time of operation; at least half of this amount should be dusted into the peritoneum.

2. Intravenous sodium sulfadiazine therapy should not be started until 24 hours after operation, after the patient had reacted from anesthesia and shock. The dosage then was not to exceed 2.5 gm. every 12 hours.

3. Sulfonamide therapy was to be promptly discontinued if the 24-hour urinary output was less than 1,000 cc. or if gross or microscopic hematuria developed. Fluid intake should be adequate to insure a minimum urinary output of 1,500 cc.

Special instructions were also given for the use of sulfonamide therapy in wounds in which clostridial myositis was likely to be encountered.

Anuria continued to occur in spite of these precautions, and the role of mismatched blood was then advanced as the causative factor. It undoubtedly explained some cases, but it did not provide a universal explanation. This type of nephropathy was also frequently observed in patients with crushing injuries and in those with very severe wounds who had been in shock for long periods of time.

In the fall of 1944, the board set up to study physiologic pathology in the severely wounded (p. 415) had the special objective of investigating lower nephron nephrosis. All patients who developed this condition or in whom it seemed impending were reported to the board at once, and prophylaxis and therapy were carried out according to their recommendations. The board's final conclusion was that no single factor was responsible for lower nephron nephrosis.[37]

Major MacLennan recommended alkalinization therapy, but no satisfactory treatment for lower nephron nephrosis was ever developed, except that it was learned that, contrary to the original practice, fluids should be limited when the condition appeared or seemed impending.

Section III. The German Medical Service in Italy

GENERAL CONSIDERATIONS

Practically all of the prisoners whom Allied medical services were called upon to treat in Italy were Germans. Since the Italians surrendered to the Allied forces as the invasion of Italy was in progress in 1943, very few became

[36] See footnote 10, p. 361.
[37] See footnote 19, p. 398.



FIGURE 76. German prisoners of war in Po Valley, May 1945.

prisoners. When Italian troops fought with Allied troops in the south of Italy, their wounded were cared for in their own hospitals. Italians who fought with German troops were treated in German hospitals; a few of them were encountered in these hospitals after the surrender that ended the war in Italy.

As for German prisoners of war, the first trickle of captured troops in the Po Valley (fig. 76) after the breakthrough there in April 1945 furnished a hint of what was soon to become a major problem. After 29 April 1945, there were few Allied casualties, and U.S. Army medical facilities became, in effect, depositories for the sick and wounded remnants of the Wehrmacht. On 3 May 1945, an Allied forces headquarters directive made captured German prisoners who were wounded or ill the responsibility of the Fifth U.S. Army medical service. Eventually, over half a million prisoners were taken, 20,000 of whom were either already in hospitals or required immediate hospitalization (fig. 77). Most German wounded were in German hospitals, and after the surrender they continued to be cared for by their own medical officers, under the supervision of U.S. medical personnel assigned to the hospitals in a supervisory capacity.

From mid April 1945 on, as more and more territory was taken and more and more troops surrendered, there were unusual opportunities to study the management of battle casualties in German hospitals. Immediately after the final surrender, on 2 May 1945, General Martin directed a number of medical officers, among them the army consultant in surgery, to visit the German medical installations and survey them as completely as possible. These observa-

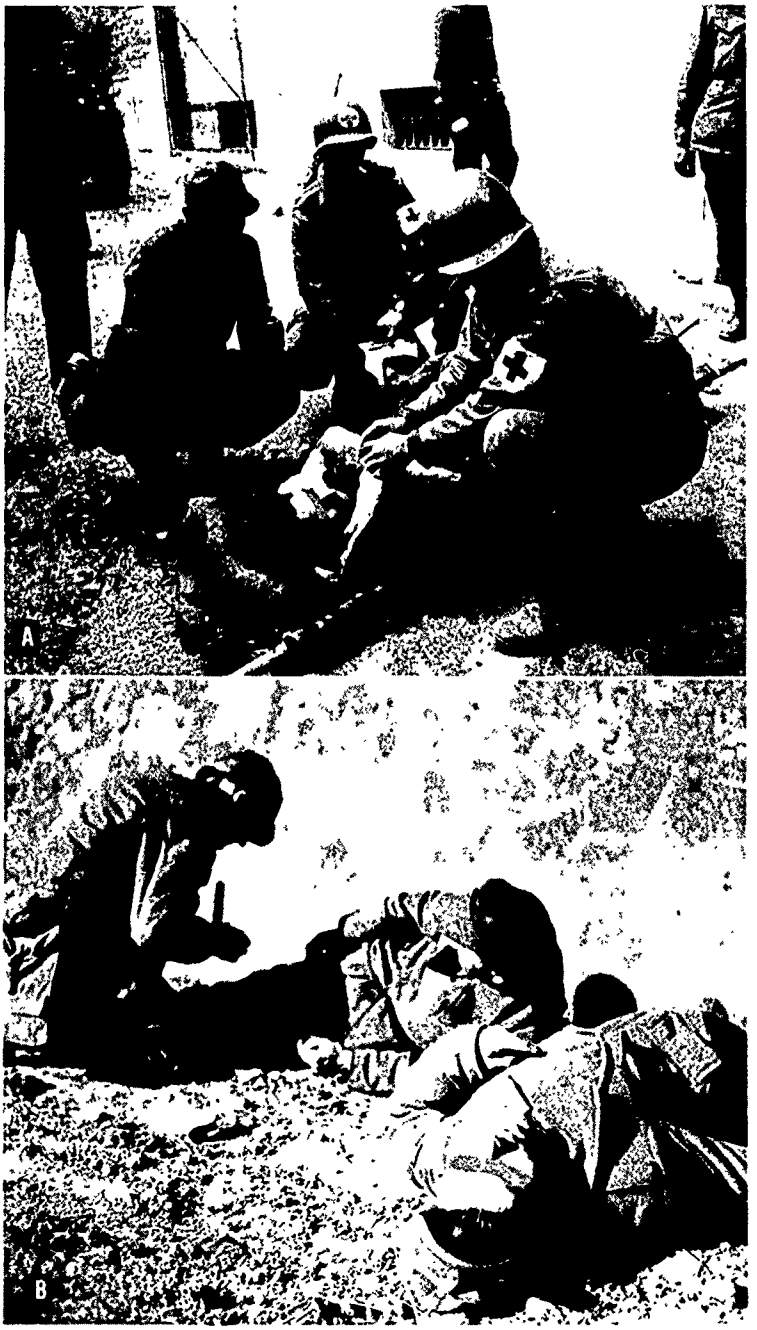


FIGURE 77 - Care of enemy wounded. A, Care of wounded German soldier by officer of 11th Armored Infantry Battalion in Silla area, Italy, October 1944. B, Care of wounded German by American medic of 10th Mountain Division in Castel d'Aiano area, March 1945. Dead German lies nearby.



FIGURE 77 Continued C Wounded German being carried into hospital which had surrendered to U.S troops in Verona area, April 1945 D American soldier injured in motorcycle crash, being cared for by German medics until the arrival of American ambulance, in Maresca area, Italy, May 1945

tions, supplemented by interviews with German medical officers in hospitals and hospital groups and with others who held staff positions in German armies and army groups,[38] yielded much information of interest.

While it is impossible to judge the standards of German military practice by the conditions found in hospitals operated by a beaten enemy after 6 years of war, there is no doubt that, since 1933, both the quantity and quality of German physicians had steadily deteriorated. By U.S. standards, observations in German hospitals showed their food and their medical and surgical supplies to be inferior and their medical and surgical practices no more than mediocre.

ECHELONS OF MEDICAL CARE

The chain of evacuation of German wounded was basically similar to that employed in the U.S. Army, although triage differed in a number of respects. The system was as follows:

1. First aid was rendered by a noncommissioned officer in an installation (Verwundetennest) located very far forward. The measures employed were limited to dressing the wound; the application of transportation splinting, traction splinting, or pressure bandages; and the application of tourniquets. Care at this level corresponded to the care given U.S. Army casualties on the battlefield by company aidmen.

2. The wounded were then evacuated to an installation (Truppenverbandplatz) which corresponded to the U.S. battalion aid station. All care at this level, as in the similar U.S. battalion aid station, was directed to preparing the casualty for evacuation farther to the rear.

A medical officer who corresponded to the U.S. Army battalion surgeon carried out much the same functions as his U.S. counterpart. The dressing over the wound was checked, but it was not disturbed unless there was some indication for the interference. An occlusive dressing was applied to an open chest wound. Tracheotomy was performed if necessary. Hemorrhage was arrested by pressure bandages, the application of a tourniquet, or, less often, by hemostat or ligature. If he required it, the patient was catheterized. Pain was relieved by standard methods. Shock therapy (physiologic salt solution, external heat by electric heaters, Periston, or Nikethamide (Coramine)) was instituted.

3. The wounded were next evacuated to an installation (Hauptverbandplatz) set up by the sanitäts company of the division about 4 miles behind the frontline. It was staffed to perform functions similar to those of a U.S. Army clearing station, but it also was equipped to hospitalize patients (fig. 78). It could care for 200 routinely, and in times of stress the bed capacity could be expanded to care for from 300 to 400 casualties. The table of organization

[38] Brig. Gen. Prof. H. Burkle de la Camp, M.D., Advisory Surgeon to the Officer in Charge of the Medical Service of the Army of the Southwest. Subject: Report of experience gained during the entire work of the Medical Service from 1939 to 1945. Reference: Oral order issued by the Officer in Charge of the Medical Service of the Army of the Southwest to prepare a report on the experience acquired, for submission to the American Occupation Authorities. Merano, June 1945.

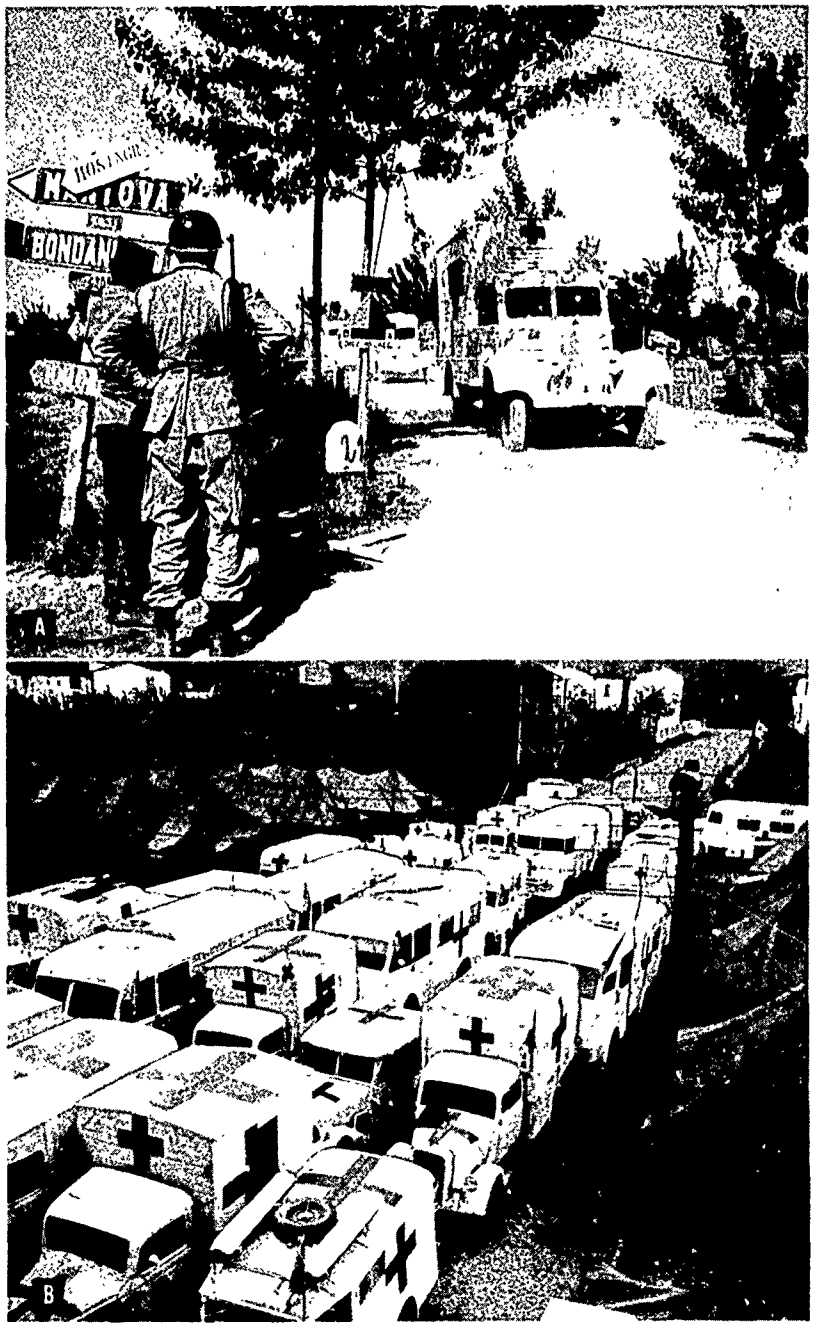


FIGURE 78 Captured German hospital and equipment. A. Complete German field hospital captured with all its equipment and personnel, April 1945. The trucks are driven by Germans and German nurses and medics are riding in them B Ambulances captured with the 334th German Hospital in the Florence area, April 1945

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provided for two operating surgeons, but, when a push was on, six or eight additional surgeons might be attached.

Primary surgery was performed on minor wounds at this installation. When the flow of casualties was light, those with abdominal wounds and other injuries which made them nontransportable also received initial wound surgery here. Casualties with craniocerebral injuries, chest wounds, and major compound fractures were evacuated farther to the rear. According to the German medical field manual, the functions of the Hauptverbandplatz included tracheotomy; closure of open chest wounds; aspiration of the pericardium in cardiac tamponade; emergency amputations; definitive arrest of hemorrhage; suprapubic cystostomy; surgery on nontransportable casualties; and administration of blood and blood substitutes.

At the beginning of the war, all army divisions had two sanitäts companies. At the end, only armored divisions and mountain divisions had two companies, though each corps surgeon had one under his control to use at his discretion. When two sanitäts companies were available to each division, two Hauptverbandplatzen were often set up.

At the beginning of an offensive, a horsedrawn sanitäts company was placed 3 or 4 kilometers behind the line, ready to receive casualties. The other company, which was motorized, was held in reserve, to be used after substantial gains had been made. If the gains were extensive and the Hauptverbandplatz was required farther forward, the motorized company moved forward, leaving its patients to be taken over by the horsedrawn unit, which left its patients, in turn, to be taken over by a Feldlazarett.

4. Next in the chain of evacuation was a unit (Feldlazarett), corresponding, in general, to a U.S. Army evacuation hospital (fig. 79). It was designed to care for 200 patients, and its table of organization provided for only 2 operating surgeons. In times of stress, however, the intrinsic staff was augmented by surgeons from other units.

Ordinarily, the Feldlazarett provided primary surgery for head wounds, transportable chest wounds, severe muscle wounds, wounds of the buttocks, and major compound fractures. When the Hauptverbandplatz was rushed, patients with abdominal injuries were evacuated for care here, though the preference was to care for them farther forward.

As this description has indicated, there were often two divisional units performing surgery ahead of the most forward field hospital. When, however, a major offensive had been launched, division, army, and army group hospitals might all perform primary surgery only on the less seriously wounded, casualties with intra-abdominal and intracranial wounds being put aside in favor of those more likely to survive and to be returned to full duty. Generally speaking, the German Army system of medical care was extremely flexible, but its flexibility tended to favor the lightly wounded at the expense of the seriously wounded, the group which U.S. Army medical officers considered first priority patients.

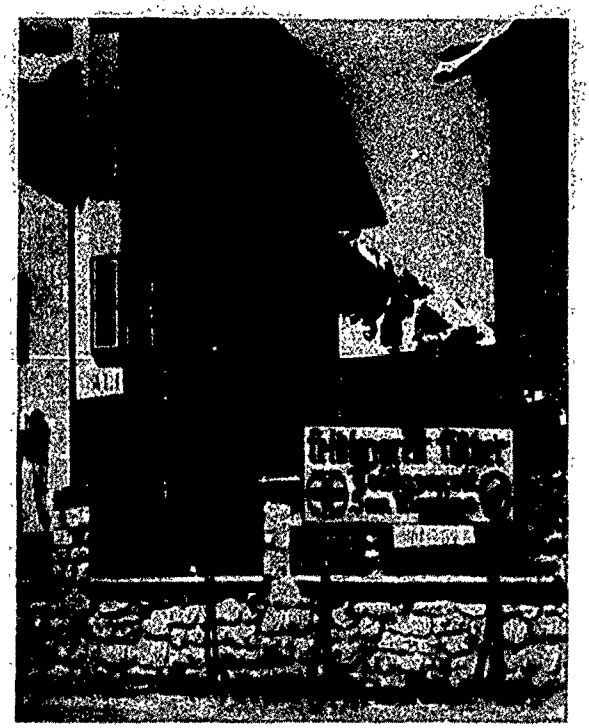


FIGURE 79.—Feldlazarett. In the German medical service, this installation corresponded to a U.S. evacuation hospital.

5. General hospitals (Kriegslazaretten) were usually assigned to an army group. In Italy, most of these installations were grouped at Merano and Cortina d'Ampezzo.

The major function of these hospitals was to care for patients who had been operated on at more forward units and who could not be returned to duty. In addition, certain casualties received primary surgery here, including those with penetrating head wounds complicated by involvement of the eyes or ears and those with maxillofacial wounds. In very busy times, such as occurred during the frequent offensives launched by both sides, all patients requiring major surgery might be evacuated to these general hospitals for it, the units farther forward being engaged in caring for men who could return to their units within a reasonable time after operation. It was not at all unusual at such times for patients with abdominal injuries, head injuries, and other serious wounds to receive no surgery at all.

6. In addition to these units, other medical installations cared for casualties with slight wounds and illnesses and for convalescents, as follows:

In each German division was an ersatz company which served as a replacement depot and reconditioning unit for lightly wounded casualties who had

received primary surgery in the Hauptverbandplatz. Patients were ordinarily held here for a week. During this time, a medical officer directed their reconditioning, which was chiefly accomplished by exercises. There were usually between 50 and 100 of these patients in an ersatz company at a single time. The staff usually consisted of medical officers who had been injured or who were on limited service for some other reason.

Hospitals for patients with slight injuries and mild illnesses were established in army areas and general hospital centers by elements of transport units (Krankentransportabteilungen). These units received their patients from the Feldlazaretten in the army area or from the Kriegslazaretten in the army group area or hospital centers. Most patients remained 2 or 3 weeks.

7. The German Army medical service had no auxiliary surgical groups. The army surgeon used personnel from reserve units or less active units to augment the staff of busy units.

Administration.—For control purposes, medical units of 100 beds were incorporated into larger units, and these units into still larger units. Hospitals found better staffed and equipped than others were invariably those designated to treat elite casualties, such as Luftwaffe and SS troops.

CONSULTANT SYSTEM

Each army group had two consulting surgeons and one consulting physician. Each army had the same number. The army group also had consultants in ophthalmology, otology, and psychiatry. Their surgical assistants were physicians who had had 3 or 4 years of surgical training after graduation from medical school.

Consultants were selected from medical schools or civilian clinics. If they had served 6 weeks in the army before the outbreak of the war, they had the rank of major; otherwise, they entered as lieutenants. Promotions were granted to officers with the civilian rank of professor, regardless of their primary grade, after they had served half the usual time requirement. A major thus became a lieutenant colonel after 18 months and a lieutenant colonel a full colonel after 3 years.

The duties of the German consultants were in general much the same as those of consultants in surgery in the U.S. Army. There was, however, one exception. When a consultant visited a hospital, he took along his assistant and a noncommissioned officer, together with a full set of instruments, because he was frequently called upon to operate, or decided for himself to operate, in special cases. The relative paucity of skilled surgeons in the German Army made the operating function of the consultant extremely important; many hospitals had no surgeons on their staffs capable of performing difficult major surgery.

INSPECTIONS OF GERMAN HOSPITALS

During the first week of May 1945, Colonel Snyder visited a number of German hospitals in all echelons of medical care, making notes on the administrative aspects of these installations and examining numerous casualties. Some of these patients had had primary surgery within the past 48 hours to 21 days, but others had been wounded a year or more earlier.

All along the roads traversed in reaching these hospitals, rail lines, railroad bridges, and other rail installations were largely demolished because of the excellent work of the U.S. Army Air Forces on the Brenner Pass and its approaches. Bombing damage was practically always confined to the areas near these targets, and transportation along the roads had therefore not been interfered with. Numerous groups of German soldiers were observed marching along the highway to the rear, without guards, although they were still armed. Convoys of troops, also without guards, were also proceeding to the rear. They were all orderly and well-behaved, and the absence of guards apparently did not move them to attempt to escape.

The following notes on special hospitals are representative of the conditions found in all of the hospitals inspected:

A Luftwaffe hospital, set up at Villa d'Este at Cernobbio on Lake Como, was operated chiefly as an orthopedic surgery center. The Germans had added a magnificent operating room to this luxury hotel, and the equipment was excellent. A small prosthetic shop was operated by three mechanics, and the patients for whom prostheses were being prepared were serving as their assistants. All parts, including metal joints, were made from raw materials in the shop. Some prostheses were constructed of wood and others of a plastic material which could be softened with acetone for molding and fitting.

The surgical standards in this hospital seemed much higher than in many others inspected. Even so, the U.S. medical officer who had been attached to it to check on the professional work done by the German staff reported that the aseptic technique here, as in most other hospitals, was far from optimum. Surgeons did not wear masks, even when performing elective major abdominal surgery or orthopedic surgery, and the incidence of wound infection was high.

At Feltre, the hospital staff consisted of 11 medical officers, 2 medical administrative officers, 1 dentist, and 5 chaplains. When this hospital was inspected on 5 May 1944, it had only 295 patients; 84 had been evacuated within the previous 24 hours.

At Feldlazarett No. 200, at Primeiro, there were 3 medical officers and 80 patients. At this hospital, as at the hospital at Feltre, the surgery was of poor quality.

At a group of three other hospitals visited the same day, the bed capacity was 1,200, and there were 860 patients. Each hospital occupied three or four hotels; one of the installations was entirely for paratroopers and another for Luftwaffe patients. The surgery in these hospitals, all of which housed high-

ranking officers and other special patients, seemed of a higher quality than in some of the hospitals which had been inspected earlier, but wound infection and gas bacillus infections were widely prevalent.

At this installation, Colonel Snyder was told of a new drug, still secret, which was being used by injection for clostridial myositis. It did not impress him as being as good as penicillin, and, since nothing more has been heard of it, his impression was probably correct.

The hospital center at Merano consisted of 14 hospitals, each occupying several hotels or other buildings. Near it, on the outskirts of Bolzano, was a hospital for the lightly wounded, with its bed capacity of 3,000 little more than half occupied. It was said that this was an unusually large number of patients for this installation. The staff consisted of 12 medical officers, 3 administrative officers, 200 enlisted men, 44 German nurses, 7 Italian nurses, and 3 Russian and 3 Italian Red Cross Sisters. The commanding officer had plans to discharge 500 of his approximately 1,600 patients within 2 weeks, 600 within 4 weeks, 300 within 2 months, 100 within 3 months, and the remainder within 6 months.

At the center at Merano, 42 Allied wounded were in process of evacuation under the supervision of Maj. (later Lt. Col.) Claude E. Welch, MC, who had been detailed from temporary duty with the 8th Evacuation Hospital for this purpose. According to the Germans, four of these patients were nontransportable.

One of this group was a U.S. Thunderbolt pilot, who had been shot down in February 1945 and badly burned. He was still very ill, little more than skin and bones, and the Germans had allowed him to become very anemic. One eye had been enucleated 2 days before Colonel Snyder's visit, because of sepsis, and the cornea of the other was white. The German plan was to give him 200 to 250 cc. of blood by direct transfusion every second day. He was given 4 pints of blood and large doses of penicillin at once and was moved to a U.S. Army hospital 48 hours later.

The ranking officer among Allied wounded in this center was a British major who had been captured in December 1944 and had undergone a mid thigh amputation. He reported that the food he had received was as good as was available and that his treatment had been generally good, though the Germans were very domineering, particularly to the Italian staff of the hospital. An Italian physician had worked in the hospital along with German medical officers, in preference to being sent to a concentration camp, and this patient reported that he had been extremely kind to all the Allied prisoners.

GENERAL CLINICAL CONSIDERATIONS

The outstanding impression gained from a survey of these and other German hospitals in Italy was that infection was many times more frequent than in U.S. Army hospitals. The generally pale and anemic appearance of the patients was in contrast to the healthy appearance of most patients in

U.S. Army hospitals. Clinical practices in the German Army medical service explained these observations. Blood was used in little more than homeopathic amounts, and an almost complete lack of aseptic technique accounted for the prevalence of wound infection, the extent of which was almost incomprehensible in the year 1945, regardless of military circumstances.

Colonel Lichtenstein, who subtitled his report to the Fifth U.S. Army surgeon "The Story of a Finger," described the ward rounds and other activities of a German surgeon substantially as follows:

He examined clinical records, X-ray films, and soiled bandages. He determined the patient's state of hydration by running his finger across his tongue. He then readjusted several mechanical supports. He shook hands with the superintendent of the hospital and other visitors on the ward. With his assistants, he examined draining extremity wounds without gloves or a mask, using the same instruments throughout and proceeding from one case to another without washing his hands. In fact, he did not wash his hands during the entire morning. Conversation over open wounds was completely uninhibited. The American observer noted that he himself did not offer to shake hands with him when the so-called rounds were over.

Under these conditions, which were of the same order though perhaps somewhat less extreme in most of the hospitals inspected, infection was practically inevitable, and interviews with many German surgeons indicated that they had come to regard it as such. A German consultant who had seen service in World War I, as well as on the Russian front in World War II, stated that infection was just as much a problem in World War II as in World War I.

Shock and hemorrhage.—German wounded received in shock were treated by external heat, stimulants, Periston when it was available, and direct blood transfusions.

The Germans regarded Periston as an excellent substitute for plasma and of such high osmotic properties that it was retained in the blood stream for 12 or 14 hours. It was furnished in 500-cc. units, and the dosage did not exceed 2 units.[39] Supplies, however, were limited, and it was not available in all German medical installations, even in units in the division area, which had prior claims on it.

All blood transfusions were done by the direct technique, in amounts of 200, 300, 500, or 800 cc. Occasionally, a casualty was given 1,000 cc., but larger amounts were never used, and most of the German surgeons questioned were opposed to giving more than 200 to 300 cc. of blood at any one time. As already noted, the extreme pallor of many patients seen in German hospitals, and the moderate pallor of most of them, supported the surgeon's statement that blood was used only in small quantities and in selected patients.

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[39] Periston has never been popular in the United States and was regarded in 1958 as a poor plasma substitute. It has been determined that it is not all excreted, a certain amount being deposited in some of the organs of the body. U.S. medical officers were in agreement with German medical officers that a maximum dosage of 1,000 cc. should never be exceeded.

At the best, it seemed that a German casualty, no matter how serious his wound or how deep his shock, would not ever receive more than 1,000 cc. of Periston and 1,000 cc. of blood. If the pulse did not return in a patient with an abdominal or other serious wound in response to this type of resuscitation, he was simply not operated on. The impression was gained that satisfactory restoration of the pulse volume was the criterion of successful resuscitation and that surgery was seldom performed if this was not achieved.

This method of treating shock and loss of blood was in sharp contrast to U.S. Army methods. In the U.S. Army, plasma was available in all forward medical units in the division and was used in large enough quantities to make casualties tranportable to field hospitals, in which banked blood was available. By the end of the war, U.S. battle casualties in the Mediterranean theater were receiving an average of 1 pint of blood each. Furthermore, casualties who did not respond promptly to vigorous shock therapy were operated on immediately and thus given their chance of life. This bold policy saved many lives.

REGIONAL INJURIES

Head injuries.—Most of the German casualties with intracranial wounds who were observed at the hospitals visited in May 1945 needed additional surgery. At the hospital center at Gardone Riviera, which Colonel Campbell surveyed on 6 May 1945, there were 40 patients with head injuries, 30 of whom needed further surgery. About a dozen patients with wounds of the spinal cord were examined, about the same proportion of whom needed operation. At this hospital, a general surgeon was in charge of neurosurgery. Maj. (later Lt. Col.) Henry L. Hoffman, MC, was assigned to it as professional supervisor.

Chest wounds.—Most of the patients with chest wounds observed in German hospitals had been wounded weeks and months earlier. About 60 percent of them had empyema. Colonel Snyder was informed that empyema could be expected to develop in about this proportion of shell-fragment wounds and that it could also be expected in about 30 percent of all bullet wounds. In the U.S. Army in World War II, empyema came to be a very uncommon complication.

Opinions expressed by German surgeons concerning the management of chest injuries varied widely in details but were fairly unanimous in respect to most principles. It was agreed that shock of some degree was present in most chest wounds and that its management must take precedence over management of the wound unless there was a wide open pneumothorax or a severe and menacing hemorrhage. When there was serious internal bleeding, or an increasing hemothorax, the patient needed constant attention; otherwise, shock might pass on to collapse, and the patient would bleed to death. When a large number of wounded men were received at the same time and the surgeons were busy in the operating room, a junior officer or intern or whoever else was available was employed to make so-called collapse examinations, to make certain that a failing circulation and serious bleeding would be reported before they became irreversible.

No surgery was done in perforating chest wounds unless there were indriven rib fragments. The policy of early, repeated aspiration in hemothorax, which was routine in U.S. Army hospitals, was not employed in German hospitals, and there seemed no general policy for the management of this complication. Some surgeons stated that aspiration was never employed unless it became necessary to relieve dyspnea associated with a large hemothorax or hemopneumothorax. Others said that aspiration was performed within the first 5 days after wounding. One consulting surgeon said that this had been the practice early in the war unless respiratory difficulties required interference earlier but that it had recently become the practice to perform aspiration as soon as the casualty had reacted from shock, usually within 48 hours after wounding.

The treatment of empyema seemed rather more uniform. Closed intercostal (Bülau) drainage was instituted as soon as infection or pus was evident. The catheter was attached to a water-seal bottle, which was usually converted into a Wangensteen-like suction apparatus by the use of two additional bottles. Drainage was continued until the cavity was obliterated. If this had not occurred at the end of 6 months, the empyema was considered to have become chronic, and thoracoplasty and decortication were employed by the modified Schede's technique. Rib resection was seldom employed.

No facilities were provided for gas anesthesia or for positive pressure delivered by an anesthetic machine. A good machine was available for oxygen therapy, but it was apparently seldom or never used for expanding the lungs during intrathoracic surgery. Endotracheal tubes were not observed in any hospital, and no chest surgeon or anesthesiologist mentioned this technique. Most chest surgery was performed under open-drop ether anesthesia or local analgesia supplemented by Pentothal sodium given intravenously.

Thoracoabdominal wounds.—Only a small number of patients were observed with thoracoabdominal wounds. None was extensive, and, in all instances, surgery had consisted of laparotomy and simple closure of the wound in the chest wall. No patients were seen who had been treated by the transdiaphragmatic surgery which was regarded so favorably by U.S. Army chest surgeons. When inquiries were made about this technique, the replies were rather vague. One surgeon stated that the thoracic approach might be used if the chest wound was large and the intra-abdominal wound small.

In the absence of facilities for positive pressure at operation, and without well-trained anesthesiologists experienced in anesthesia for chest surgery, it was concluded that the German wounded could not have had the advantages of modern intrathoracic and transdiaphragmatic techniques.

Abdominal wounds.—Only a small number of patients with abdominal injuries were found in the German hospitals which were captured and in those which fell into U.S. Army hands when the mass surrender occurred. This is not surprising if one conside s the tactical situation during the preceding weeks and the German policy of care of casualties, which favored the less seriously

wounded. It seems doubtful, in the confusion of the final weeks of fighting and the heavy casualties associated with the crushing German defeat in the last push, that many casualties with abdominal injuries were fortunate enough to undergo any surgery at all. In the combined hospitals at Merano, in which 6,917 casualties had been collected by 6 June 1945, there were only 264 patients with abdominal, thoracoabdominal, or combined thoracic and abdominal wounds, and 112 of these were listed as superficial wounds.

Only two patients who had undergone abdominal surgery were observed by Colonel Snyder, both of them in the same installation. One of them had had a negative exploration and had developed a huge incisional hernia. The other was making a satisfactory recovery after surgery on the small intestine.

It was evident, in spite of these observations, that the Germans were impressed with the advantages of early surgery in forward installations for intra-abdominal wounds. The army manual of surgery recommended it, and German surgeons stressed it in interviews held with them.

One surgeon described a Hauptverbandplatz on the Russian front in which 37 operations for abdominal injuries had been performed over a 2-month period. There were eight deaths. The timelag was usually 2 hours; when it rose to 6 or 8 hours, results were less good. This hospital was located close to the front line, which was well stabilized, and the Germans were well dug in. Also, the casualty load was not heavy. Surgery could therefore be performed in the division area on almost all patients; not more than six or seven were evacuated, for various reasons, to the Feldlazarett farther to the rear.

Even when conditions were favorable, however, it was clear that patients with abdominal injuries who did not respond to shock therapy did not have emergency surgery unless there was reason to believe that shock was produced by intra-abdominal hemorrhage. It was not clear, from the replies to questions, how the distinction was made between shock due to intra-abdominal hemorrhage and shock due to massive peritoneal contamination.

Techniques of abdominal surgery, when it was employed, seemed much the same as those used in U.S. Army hospitals. Wounds of the liver were drained. Wounds of the stomach and small intestine were repaired unless the wound was so extensive that resection was necessary. Small wounds of the colon were usually repaired, after which proximal cecostomy was usually done. Large wounds of the colon were exteriorized.

It is doubtful that the Germans, without whole blood in adequate amounts and using only the direct technique of transfusion, could have improved their results in wounds of the abdomen even if they had attempted surgery on these desperately wounded casualties. What U.S. Army surgeons accomplished in this group was due not only to their own skill but also to the skill and superior equipment of their anesthesiologists, the judicious use of banked whole blood, and the use of oxygen and all the other facilities and equipment which the U.S. Army provided to insure the best possible care for every wounded man.

Wounds of the extremities.—Most wounds of the extremities were treated primarily in the Hauptverbandplatz or the Feldlazarett. The careful wound excision practiced by U.S. Army surgeons was practically unknown. One German surgeon stated that he had done only five or six such operations during the entire war; he had performed primary wound closure in all of them.

Many of the patients seen in German hospitals had had little or no excisional surgery. Treatment seemed to have been limited to incision of the skin and fascial planes, excision of devitalized edges of skin wounds, and removal of gross debris and devitalized tissue. Whether the devitalized tissue present in many of the wounds examined had been left in situ or had developed after inadequate debridement it was not possible to say. Unless the wound was large, perforating wounds associated with fractures were often treated without surgery, as were all bullet wounds. As a result of these practices, infection was frequent and extensive, and there was a great deal of gas edema and actual gas gangrene.

One surgeon described the management of badly damaged heels by excision of the talus, calcaneus, and half the scaphoid and the cuboid. He then put the foot in the drop position, in which it was anchored with Steinmann's extension pin. The patients were then fitted with below-the-knee prostheses, which they wore most of the time. He reported good functional results in a quarter or a third of the patients treated by this method; amputation was necessary in the remaining cases.

Wounds of the joints.—Perforating joint wounds from small arms or high explosive shell fragments were frequently treated without surgery unless there was a large wound of exit. When infection developed in knee joints in which fractures had occurred into the joint, drainage was sometimes tried tentatively, but more often resection was resorted to at once. Resection of the elbow, wrist, and shoulder joints was also sometimes done to control infection. Most patients observed in German hospitals after joint resections were still septic. Infected wounds and resected joints were often treated with irrigations of Dakin's solution.

Splinting and traction.—Compound fractures of the femur were put up in skeletal traction, with Kirschner wires, whether they were treated in field or general hospitals. When infection developed, the limb was incorporated in plaster, but some traction was usually contin[illegible] In fractures of the head of the femur caused by shell fragments, the femoral neck and head were usually resected at initial wound surgery.

Techniques of splinting varied. In some simple fractures of the femur, unpadded walking plaster spicas were used after the method of Böhler. Similar spicas were used in some compound fractures after the soft-tissue wounds had healed. These walking spicas were not used in the early management of fresh compound fractures from bullet or shell fragments as Trueta had used them in the Spanish Civil war.

Some surgeons favored the use of wooden or wire ladder splints for several days after operation; then plaster casts, which were always padded, were applied. Other surgeons used plaster immediately after operation. Windows were cut into the cast to provide for dressing the wound and for the management of infection, the anticipation of which seemed to be routine.

An ingenious apparatus made of perforated metal pipes served as an excellent substitute for the Balkan frame. It was capable of many combinations, since the pulley wheels could be adjusted to the desired position for any sort of traction. Sometimes a complete Balkan frame was constructed from these pipes, but more often a single pipe clamped to the metal hospital or hotel bed was used to support sidearms which provided the necessary number of pulley wheels in the desired position.

In the hospital at Cernobbio, Colonel Snyder encountered two German surgeons who had been using the nail devised by Küntscher for the management of fractures of the femur and other long bones. One of them, the chief of surgery at the hospital, had participated in the original work at the University of Kiel in 1937. He had the records of 550 clinical cases in which this method had been used and in many of which he had done the operation. There were no fatalities in this group, but there were some instances of fat embolism. The original experimental work on animals carried out at various periods after nailing showed that about a third of the bone marrow is destroyed when the nail is inserted and that small fat emboli are nearly always dislodged.

The German Army had prepared a booklet describing in detail the technique and the indications for this method of fixation. In fractures of the femur, a straight, rigid nail was used; it was driven down through the trochanter and into the distal fragment under fluoroscopic control. The nails used for the other bones were flexible and slightly curved.

The surgeons interviewed at Cernobbio stated that for a time many surgeons had attempted to use the Küntscher nail, with disastrous results. Osteomyelitis had developed, and there were some deaths from shock. After the original wave of enthusiasm had thus been quenched, a few qualified surgeons were designated to use the technique when they considered it indicated. In the opinion of the surgeon who had worked with Küntscher, the intramedullary nail should be used only on strictly limited indications, chiefly in closed fractures of the middle third of the femur, in which the fracture line was transverse or almost transverse. These patients could walk without additional splinting in from 8 to 10 days after nailing. Küntscher's former associate did not consider the nail indicated in fractures of the tibia, humerus, radius, or ulna, though he did use it in compound fractures of the femoral shaft after wound healing or when healing was occurring without infection.

The other surgeon at Cernobbio had used the technique in a few infected compound fractures of the femur and the humerus when the desirability of fixation seemed to outweigh the risks of introducing a nail in the presence of infection.

CHAPTER XVII

Sixth U.S. Army

Frank Glenn, M.D.

The military action in the Southwest Pacific Area was complex and unique in comparison with that in other theaters during World War II. It was complex because it involved amphibious landings, carrier-based and land-based air support, and infantry warfare with artillery support aided by tanks and flamethrowers in tropical jungle well defended by the enemy. It was unique in that there were numerous combat actions in various phases going on simultaneously over a wide geographic area. Thus, while one action was at its height, others were being initiated or completed. Planning was continuous and sometimes difficult to fulfill because of great distances between point of staging, embarkation, and invasion. These circumstances established the desirability for providing adequate surgical care that was not infrequently definitive in the most forward areas for the severely wounded.

DUTIES AND FUNCTIONS OF SURGICAL CONSULTANT

Early in 1944, Maj. (later Lt. Col.) Frank Glenn, MC, was an assistant to Col. William B. Parsons, MC, Consultant in Surgery, SOS (Services of Supply), SWPA (Southwest Pacific Area). Concurrently, Major Glenn was in charge of special projects at the direction of Brig. Gen. (later Maj. Gen.) Guy B. Denit, Chief Surgeon, USAFFE (U.S. Army Forces in the Far East). In these capacities, Major Glenn visited the Sixth U.S. Army surgeon, Col. (later Brig. Gen.) William A. Hagins, MC. Although the specific purpose of this visit was to instruct forward medical units in the use of penicillin which had just been made available in limited quantities to the SWPA at the request of Colonel Hagins, two additional objectives were undertaken. The first of these was to evaluate the type of surgery performed in forward combat-area hospitals and the second was to brief and instruct personnel of hospitals assigned for the first time to the Sixth U.S. Army—hospitals that had had no experience under combat conditions.

During the following months, until October 1944, in carrying out the duties of a surgical consultant, Major Glenn was able to visit both SOS and Sixth U.S. Army units. It therefore evolved that, after making a tour of the medical units in the forward area, the consultant would return to those in rear bases. Thus, an opportunity was presented to observe how the casualties of one campaign were cared for in the most forward combat areas and to follow

them through the chain of medical evacuation to the fixed hospitals in the rear. It was the result of this overall picture that enabled a surgical consultant to make suggestions to the surgeon in the forward area. Furthermore, such liaison relayed information to rear units that gave them a better understanding of the problems encountered by the forward medical units.

There were certain differences between the problems of the theater consultant and an army consultant. Particularly was this true where the actions were relatively small and took place at intervals of great distance. Throughout the SWPA after the Buna operations, assault landings were of an amphibious nature, and the number of troops employed varied from a small task force of a few hundred men to a force of several divisions. Each military objective presented different problems. The medical units accompanying such combat forces functioned for various periods and then were comparatively idle. The army consultant was confronted with the problem of having varying numbers of new medical units for only a short time before action and then for relatively brief intervals during the active phase of a campaign. He then moved on to a somewhat similar episode in the next step. It was difficult for him to know the exact capacity and ability of the surgical personnel of these units. It was because of these circumstances that the army consultant, if he was to assist in giving the wounded the best care, required that surgical personnel assigned to forward medical units where surgery was to be performed—evacuation, field and portable surgical hospitals—be of the very best. In the type of warfare carried on in the SWPA, well-trained and mature surgeons were of greater critical and immediate importance in the forward medical units than in the rear bases. Surgical skill and judgment were urgent in the care of the wounded. If this service was available in the forward area, human life as well as limb could be conserved. The forward area was where the seriously wounded either died or lived, and the period required to determine this was relatively short. On the other hand, if a wounded soldier reached a fixed medical installation in a rear base, whether he returned to duty or was evacuated to the Zone of Interior was largely a matter of the type of wound. Skill and mature judgment on the part of the surgeon in the base increased or decreased the time period required for the proper disposition of these wounded but rarely determined the life or death of the patient.

The affiliated general hospital units in the SWPA had an abundance of surgical talent. The 400-bed evacuation hospital units frequently had only one well-trained surgeon, and in some field hospitals the best trained surgeon was of mediocre ability. The portable surgical hospitals, when they were first organized in the SWPA, had officer personnel of a superior type. Their surgeons were for the most part selected from affiliated units. It was the quality of the medical officer and his training, ability, and maturity that established the portable surgical hospitals in the eyes of the SWPA. More attention should have been paid to the allocation of professional personnel. There was reluctance on the part of SOS, SWPA, to release surgeons for duty in the forward



FIGURE 80.—Lt. Col. Frank Glenn, MC, Consultant in Surgery, Sixth U.S. Army.

area because they wished to keep them in the bases. This attitude led to the delay in sending surgical teams to the forward area.

Major Glenn was assigned as surgical consultant to the Sixth U. S. Army on 1 October 1944 (fig. 80). He was familiar with the organization of this army as a result of numerous visits to organizations assigned to it during his period of service with the Surgeon, SOS, SWPA.

The Philippine campaigns then about to begin were the largest military operations yet to be undertaken in the SWPA. Throughout the Leyte campaign, which was a difficult one because of the weather and tactical situation, the surgical consultant was unable to cover each surgical service as frequently as he would have liked. Later, in the Luzon campaign, at the request of the Sixth U.S. Army surgeon, Lt. Col. George O. Eaton, MC, Consultant in Orthopedic Surgery, SOS, was placed on temporary duty with the Sixth U.S. Army. He and the surgical consultant together were able to maintain a closer relationship with a larger number of surgical services.

The supervision of the surgical activities of an army was dependent upon many factors, one of the most important of which was an accurate knowledge of the personnel of the various surgical units. Insofar as it was feasible, surgical units were visited by the surgical consultant prior to their embarking upon a mission. It was customary for the surgical consultant to visit the hospital and inform the commanding officer of the purpose of his visit. Thereafter,

he would talk to the chief of the surgical service explaining the duties of the consultant and how these could best be accomplished for the benefit of the wounded. Time permitting, 2 or 3 days would be taken to gain an insight into the background, training, and personality of the individuals on the surgical service. During this period, meetings were also held to outline the general principles to be followed in the care of the wounded and to discuss any problems that might appear to be peculiar to the oncoming mission. In many instances where the unit had not formerly been in action under combat conditions, one encountered considerable enthusiasm and an equal amount of ignorance of forward area surgery. The surgical consultant found it difficult to understand how surgeons who had been in the military service for 1 or 2 years or longer and who presumably were trained for duty with combat troops could appear to have so little factual information concerning the task before them. The commanding officers of many of these hospitals had little information as to how their men performed in action.

Some commanding officers had joined the units some time after their organization, even as late as the day of embarkation, and had had no opportunity to see their personnel work together in a hospital. Information available to these hospital commanders was frequently limited to such data as appeared on the personnel record—Officer's and Warrant Officer's Qualification Card (WD AGO Form 66-1). By direct association, however, with the professional staff during the period of travel and staging, these hospital commanders were usually able to evaluate fairly well the adaptability of individuals. The information obtained by the surgical consultant from these initial visits concerned generally the training and qualifications of the professional members of the surgical staff. The outstanding surgeons were readily recognized, and likewise those who had very little in the way of training or experience. Many of the surgeons, however, could not be accurately evaluated from the contact of this one visit. It was true that gross misfits were sometimes found, and, when they were, their disposition was discussed with both the chief of the surgical service and the commanding officer and proper recommendations were made for a shift within the organization to resolve the problem. If, however, the transfer of the misfit to another organization was required, then, following discussion with the hospital commanding officer and his chief of surgical service, recommendations were made to the army surgeon to correct the malassignment. Generally speaking, commanding officers were cooperative; the chief of the surgical service was more directly concerned and was usually more aggressive in correcting an unfavorable situation. Failure to secure cooperation was encountered where there was a close personal relationship between the officer in command and a staff member. Under such circumstances, commanding officers were reluctant to accept the consultant's recommendations and offered excuses of various types for the individual.

In an effort to secure uniformity of policy in handling cases, discussions of a common pattern were presented before all units, and at the same time

directives that had been issued by the army surgeon on the recommendation of the surgical consultant were given to each medical officer. During these discussions, officers were given an opportunity to ask questions in order to clarify various types of treatment. Although these meetings were well attended and enthusiasm and attention were excellent, later experience showed that many medical officers disregarded or forgot policies that had been clearly defined. This resulted in recurrence of mistakes that were common to many units operating in the forward area. Following these visits, the surgical consultant reported to the army surgeon his evaluation of a unit as a whole and made recommendations for strengthening the unit, and, if an excess of unusual talent was found, names of such officers were listed for use in other units. It was not possible to see all units before their arrival in the combat area because some of them came from other areas and, in some instances, although they were within the area, they were inaccessible. The Sixth U.S. Army surgeon was most interested and concerned in the evaluation of the personnel of the surgical services of the various medical units. Cooperation was complete and at no time were recommendations by the consultant regarding the change of personnel not accepted. It should be emphasized, however, that all deficiencies were not corrected because replacements were often not available.

In evaluating the ability of operating surgeons assigned to medical units destined to function in combat areas it was evident that certain fundamental prerequisites were overlooked by those evaluating surgeons within the Zone of Interior. Surgeons for forward area units had to be particularly well balanced and mature if they were to carry out the duties of a chief of service or a section chief. Highly developed specialists with backgrounds suggesting unusual accomplishments were sometimes found ineffective in these units. In the selection of personnel for a field or evacuation hospital, it was necessary to take into consideration not only the type of surgery that was to be performed but also the conditions under which it would be accomplished. Highly emotional, easily excitable, and impatient individuals were a detriment to this type of medical installation.

As an army moved forward into a combat area, the surgical consultant followed the medical units entrusted with the care of the wounded. Definitive surgery in the Sixth U.S. Army was done in portable surgical, field, and evacuation hospitals for the most part. After amphibious assault landings, the wounded were cared for by the Navy until one of the above organizations, or part of it, could be established ashore and set up for operation. As these installations were established and expanded, the surgical consultant attempted to maintain an overall picture of their actions. This was facilitated by the Medical Section, Headquarters, Sixth U.S. Army, for here information on the location and the patient load of each medical unit was at all times available. The general plan was to keep in close touch with those units that were carrying the heaviest patient loads. In Leyte, for instance, the evacuation hospitals did most of the definitive surgery during the early days of the fighting (fig. 81).

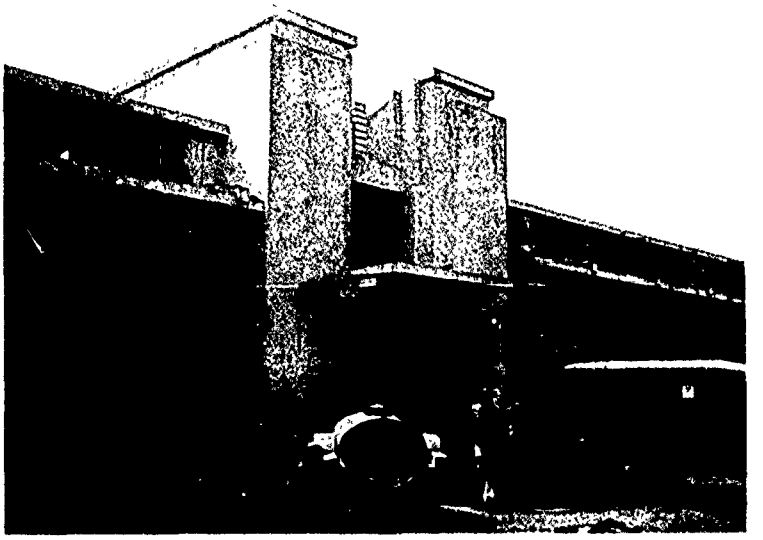


FIGURE 81.—The 58th Evacuation Hospital at Tacloban, Leyte, 25 October 1944.

Sometimes the surgical consultant would make one of these hospitals his headquarters, giving particular attention to the condition of the patients who arrived, watching in the operating room, correcting practices that were to be discouraged, and, not infrequently, taking a hand in an operation to demonstrate how the procedure might be improved. Rounds were made with surgical offices ranging from ward officers to the chief of services. There was no question in the mind of the surgical consultant that this was where a true evaluation of surgical personnel was to be made—by direct observation of the surgeons in action. The preoperative preparation of the wounded, a decision as to when an operation should be performed, the judgment and dexterity exercised at the operating table, the postoperative care, and the interest accorded the patient made up the most important items that determined a surgeon's efficiency.

The well-trained surgeon with years of clinical experience back of him, mature in judgment, and reasonable in reaction to adverse circumstances was the one individual in this war who contributed most to the brilliant record of the Medical Corps as far as the professional care of the wounded in the forward area was concerned. It was not amiss to point out that it was there that the capable medical officers put forth superhuman effort, sleeping only a few hours a day, working continuously, and doing more than one individual was reasonably expected to accomplish. This effort was required not because there was a shortage of medical officers so far as table of organization strength

was concerned, but because the abilities of all those who held authorized positions in the medical units were not comparable.

The surgical consultant viewed his tasks as being concerned with maintaining as high a standard as possible for the surgical care of all the wounded in the army. In this, the army surgeon, General Hagins, concurred and provided all possible cooperation and support. In order to accomplish this, it was necessary for the consultant to see firsthand as many of the wounded as possible along the chain of medical evacuation from battalion aid stations to the rearmost hospitals. In the early phase of an action while the advancing perimeter was relatively small, this was easily done, but as the area increased there came a time when the consultant was able to see only a few of the medical units functioning each day. Their numbers increased as the days passed and the total area over which they were scattered became larger. For example, in Leyte, until the front extended into the Leyte Valley, operations were confined to within a few miles of the Leyte Gulf and all casualties were funneled into a relatively small area. Evacuation was from one airstrip and by water back to the rear bases. If the consultant was familiar with the units and kept their locations in mind, and if he knew the surgeons, he was able to be of invaluable aid to the army surgeon when new and unexpected problems arose. As a perimeter moved rapidly and extended its fingerlike projections several miles, as in the Leyte Valley, and medical units were for periods inaccessible, support was sent forward to bolster deficiencies that might have been anticipated. Evacuation points were excellent places to gain quickly an overall picture of what was being done in the surgical care of the wounded. Furthermore, other factors that had a bearing on the care of the wounded were much more apparent at evacuation points than in the individual units. Such factors included the tactical situation, its bearing on transportation, and the availability of beds, which in turn determined the evacuation policy to rear bases.

The weather, roads, and transportation in turn influenced the number of beds that were available just as the same factors played a role in the transportation of patients from medical installations to evacuation points (fig. 82). The patients, as seen at these points, gave a fair cross section of what the hospitals from which they came were doing, for the quality and style of craftsmanship followed the pattern of the talent that produces it. One of the most effective methods for correcting improper practices was to list patients and what had been done and then to visit the hospitals involved and, through their commanding officers and chiefs of surgical service, present the findings to the responsible medical officer. When areas to be covered were small, the consultant could keep in direct contact with chiefs of surgical services by frequent visits.

The surgical consultant going from one surgical service to another and with an overall view of the wounded was always able to indicate something of what the immediate future might hold. Preparation for a heavy casualty load always facilitated the actual caring for it. Innovations in one unit were suggested in others; likewise poor procedures in surgery were avoided.

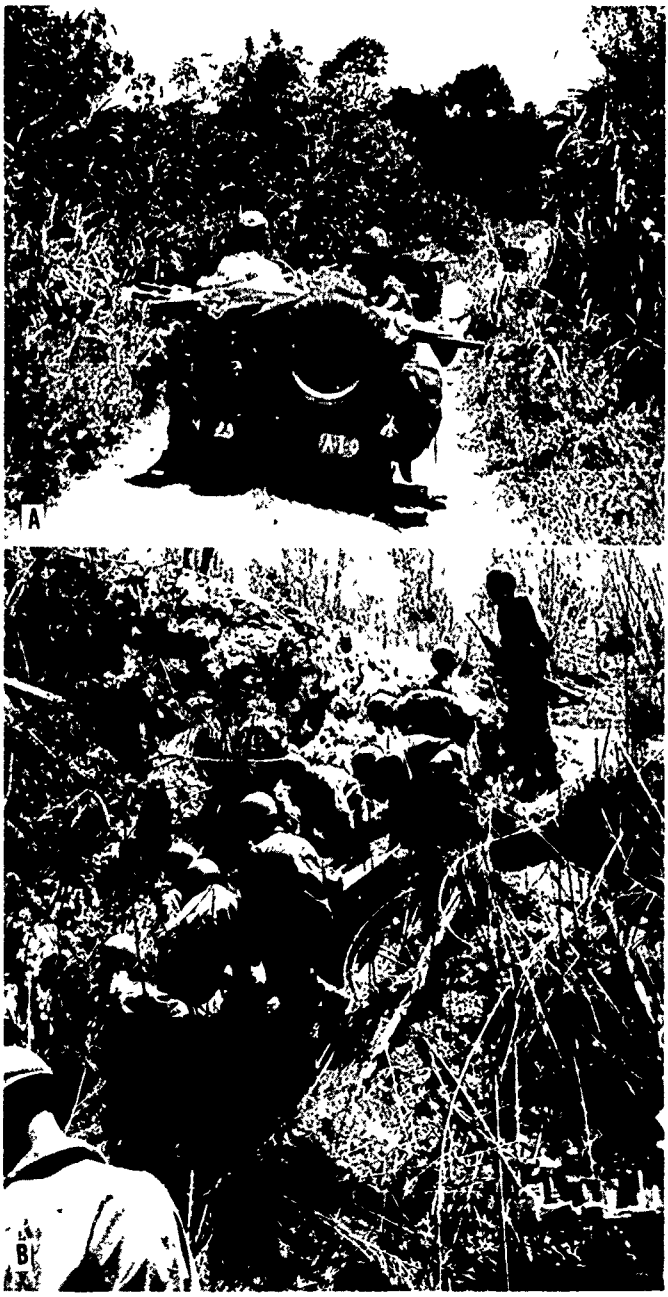


FIGURE 82 Evacuation on Luzon was difficult after the Japanese retreated high into mountainous areas. A. The evacuation of casualties by collecting company jeep ambulances to a portable surgical hospital. Jungle terrain offered excellent cover for snipers. B. In mountainous areas, many hands were required to evacuate patients. Note that a portion of aid station is in defilade (lower right corner).



FIGURE 82.—Continued. C. A team of 15 native Filipinos was required to evacuate one casualty down steep mountain slopes. Six were litter bearers; the others formed a human chain to prevent litter bearers from sliding or falling from cliffs bordering the trail.

Failures to follow policies previously set down by the surgeon in the surgical care of the wounded were best corrected on the spot. Direct explanation usually corrected the improper practices in the recalcitrant, but actual demonstration was the best means of telling another surgeon how a procedure should be done. No surgical consultant should have been inhibited in operating to demonstrate what he wanted done. He likewise should have been willing to assist any of the surgeons in his area when asked.

When, as in the Lingayen Valley, long and irregular lines were formed and extended until a large number of medical units were distributed over several hundred miles, it became impractical to see all surgical services at frequent intervals. The general practice was to bypass those that were self-sufficient and to concentrate on those that required help. If indicated, such units were quickly reinforced by surgical teams with superior talent.

Although the Luzon campaign extended over a larger area, transportation was seldom a problem because the weather was dry, there were hard-surfaced roads, and L–5 Cub planes were available. Thus, patients could for the first time in the SWPA be transported considerable distances quickly to field and evacuation hospitals. By and large, the portable surgical hospitals were no longer called upon to do so large a proportion of the primary definitive surgery. Because of overall circumstances referred to elsewhere, portable surgical hospitals, prior to the Luzon campaign, had to do more than it was ever intended they should. Working under trying combat conditions, the surgeons of these

small units had for the most part functioned in a manner that stood out as a tribute to American surgery. It thus became a matter of pride and tradition for portable surgical hospitals to do more and greater surgery. Unfortunately, many of the oldest of these units by this time had lost their most capable surgeons by rotation, and replacements were too often surgeons of limited experience. The same was true for many of the new portable surgical hospitals. It required emphatic instructions to persuade them to do only what was indicated rather than what they were willing to attempt. It was fortunate that at this phase of the war the field and evacuation hospitals reinforced with surgical teams could be utilized as intended.

The surgical consultant attempted to make himself available at all times for problems that were constantly occurring. Little time was spent in the army surgeon's office during active periods of combat, but the office kept in touch with him. Availability had to be stressed; critically ill wounded soldiers did not wait. If help was to be effectual, it was not to be postponed. If a surgeon in a forward unit asked for help or advice, the consultant could rest assured that his services would be appreciated.

The consultant also concerned himself with seeking out hidden talent. No army the size of the Sixth U.S. Army in World War II could have been expected to have all persons, including medical officers, in the positions for which they were best fitted. Medical officers well trained in surgery were found in positions where no surgery could be done. Anesthesiologists, too, were found in line organizations doing a minimal amount of medical work. It should also be mentioned, however, that all medical officers who claimed to be misplaced and who desired a change could have readily misled a consultant who had a sympathetic ear.

The problem of promotions became an item of great concern in the forward area after units and/or officers had been on foreign duty for a year or more. Many well-trained medical officers, some of whom were eligible for classification as specialists and some of whom had passed their respective boards, accepted lower rank than they should have on entrance into the service. In particular, this seemed to have been true for those doctors without previous military experience. At the same time, doctors in reserve military organizations too often were given rank that was not justified on a basis of professional qualifications. Many medical officers thus found themselves overseas with organizations under circumstances that fixed their rank or at least made promotion unlikely so long as they remained in the assignment they occupied at the time they arrived in the oversea theater. It was true that the policy of promoting lieutenants to captains enabled the lowest grades to be properly dealt with. But other medical officers in the SWPA who had worked efficiently and well for 2 years in the New Guinea jungle but who remained captains and majors—the grades they were given when they entered military service—had just cause for complaint.



FIGURE 83.—Administration of plasma at an aid station, Leyte Island, Philippine Islands

TRIAGE, TREATMENT, AND EVACUATION

The treatment of the wounded soldier in the Southwest Pacific was a step-by-step procedure. Triage, so evident in the accounts of World War I, was always of the greatest importance in the forward area. Although no one medical unit could very often care for the seriously wounded from injury to recovery, all units were involved in triage and one or more steps in treatment. The handling of casualties was, in a sense, of an industrial pattern with certain stations for certain steps. These began with the emergency medical treatment given by aidmen and litter bearers as the first step: control of hemorrhage, administration of morphine, application of a dressing, or immobilization of a fracture. The second step often included a completion of the emergency medical measures of step one, the administration of plasma or even whole blood in a battalion aid station, and additional supportive measures for transportation to a clearing station and portable surgical hospital where definitive surgery might be undertaken (fig. 83). The seriously wounded were carefully reevaluated at the clearing station and portable surgical hospitals. The patient was viewed not only in the light of his specific wound or wounds but as a whole, and, at the same time, the distance and circumstances involved in transporting him farther to a field or evacuation hospital were considered.

If transportation was a simple matter, then the most important phase of triage occurred in field and evacuation hospitals. Thus, in the Southwest Pacific, the portable, field, and evacuation hospitals were the important stations for the seriously wounded. It was in these that the very important third step, definitive surgery, was accomplished.

It was here then that mature judgment, straight thinking, and sound conclusions provided for the greatest good for the greatest number. Once the patient's status was established, preoperative treatment was begun and followed by the indicated surgical procedures. The procedures followed were based on the overall policy that provided first, for the saving of life; second, for the preservation of a part; and third, for the maintenance and restoration of function. Definitive surgery that failed to contribute to these was contraindicated. For the majority of wounds, the indicated procedures were simple. There were a limited number of injuries that required heroic procedures involving considerable technical detail. Head, intrathoracic, and intra-abdominal wounds were examples and required that the simplest procedure that accomplished the desired end was the one of choice. For instance, it was more important to deflect the fecal stream in injuries of the pelvis involving the rectum rather than to do extensive procedures that aimed at an end result such as might be undertaken in civilian practice under the most ideal surroundings. If procedures were not lifesaving or if they increased the hazard of treatment even though reconstructive, they were not considered justifiable. These procedures could be taken care of later when life would be more secure, either in rear area hospitals or in hospitals designated for reconstruction work in the United States.

The forward area hospitals concerned with triage in the SWPA attempted to direct the care of the wounded so that, first, life and limb would be preserved; second, the lightly wounded would be returned to duty as early as possible; and third, as a link in the chain of medical evacuation, their facilities would be kept available for new casualties. It followed that in order to accomplish this pattern, patients who could withstand transportation better before definitive surgery than after had to be operated upon, when possible, where the necessity for moving them after operation was reduced to a minimum.

In the process of triage, treatment, and evacuation, all the exigencies of war were involved. So varied were these from operation to operation, from campaign to campaign, and from day to day in the Southwest Pacific forward areas that no rules could have been set that would have covered the various questions that arose. Only general policies could be set forth and the employment of these left to those who at the time and place were responsible. Only they could and did have the accurate picture of the various problems. The care of the wounded, triage, treatment, and evacuation in tropical jungle, on the one hand, and on the plains of Luzon, on the other, were different in detail but



FIGURE 84.—Litter evacuation through rain-swollen streams on Leyte.

not in objective. All things considered, they were accomplished equally well in both types of terrain.

PHILIPPINE ISLANDS CAMPAIGNS

Leyte

The invasion of the Philippines at Leyte, the largest operation yet to take place in the Southwest Pacific at that time, involved an entire field army. It began on 17 October 1944 and was declared ended on 1 July 1945. Sixth U.S. Army participation in the campaign was from 20 October 1944 to the end of the year. During the most active combat operations (until the end of December 1944), almost 9,000 wounded were cared for in army medical installations. From the outset, acceleration of the assault date created a difficult medical situation.

Adequate surgical care of patients was rendered difficult by the comparative isolation of certain forward units in the field, by the frequently long litter carries from place of wounding to the installation providing emergency surgery, and by the difficult weather and terrain (fig. 84). Long and uncertain lines of evacuation, Japanese roadblocks, and other factors at times combined to force installations to perform surgery beyond their planned scope, to hold



FIGURE 85.- Tent housing operating facilities of a portable surgical hospital at Consuegra, Leyte Island

patients who should have been evacuated more promptly, and to evacuate patients who should have been held until fully transportable. A great deal of the surgery was performed in portable surgical hospitals attached to divisional clearing companies (fig. 85). These hospitals saved many lives which would otherwise have been lost. These small units were, however, limited in personnel and equipment, and they lacked the facilities to give postoperative care. The early performance of operations upon patients with abdominal injuries was of great importance, but such patients could not be moved for some time afterward. Here, for example, it was not always possible to adhere to the policy of holding abdominal cases for 10 days after operation, and a mortality higher than had been anticipated resulted. Difficult evacuation fro , battalion aid stations to surgery, requiring days in certain extreme instances, made it impossible always to operate on critical cases within the 6 hours after wounding when the chance of success was greatest, and it was reported that the average interval between wounding and operation was longer than in previous campaigns. Additional surgical teams might have strengthened the forward surgery, but most of the surgical problems arose out of the tactical situation. Gas gangrene was more of a problem on Leyte than at any time previously in the Southwest Pacific. Penicillin was used more widely in Leyte than in any previous operation, as was whole blood that was made available by air shipments directly from the United States.

Evacuation and field hospitals were broken down into sections and operated as independent units. The evacuation and other hospitals that were established early near the beaches and were functioning by D + 2 or D + 3

gave excellent surgical care to the wounded because of adequate personnel, equipment, and proximity to the source of the patients. As the forces moved inland, the picture changed. A single road in the Leyte Valley with its lanes into the hills over which American troops could advance soon became impassable with continuous rain and truck traffic. It was not unusual for troops to be isolated on high ground by high water, Japanese roadblocks, or impassable roads. There was no continuous advancing line. Unlike the portable surgical hospitals and clearing stations, the evacuation and other larger hospitals which were first set up could not be moved forward under these circumstances. Small forward hospital units were on occasion shelled out of position, and the perimeters of some were penetrated by the enemy.

Luzon

The invasion of Luzon by Sixth U.S. Army forces began on 9 January 1945. There had been ample time for planning with the result that provision for adequate medical support was accompanied by a policy of selecting highly qualified surgeons for field and evacuation hospitals. Furthermore, these units were supplemented with surgical teams. From January until the latter part of April, there occurred approximately 27,000 wounded. In contrast to the Leyte campaign, the overall tactical situation was ever favorable; there was a minimal display of hostile airpower so far as the ground troops were concerned. The weather was dry and pleasant. There were numerous hard-surfaced roads, and transportation for the wounded was adequate. Cub planes (L-5 type) were also available in fair numbers for the first time (fig. 86).

Each division had allocated to it one evacuation, one field, and two portable surgical hospitals. To each evacuation hospital one surgical team was attached, and, to each field hospital two surgical teams were attached. The teams had been selected from hospitals in the rear bases by the theater surgeon on the recommendation of his surgical consultant and for the most part were well known to the surgical consultant of the Sixth U.S. Army. It followed, therefore, that in the forward area the strongest teams were assigned to those hospitals that had the lesser amount of superior surgical talent or that promised to have the heaviest casualty loads.

The surgical care accorded the wounded on Luzon was of a high degree of excellence and superior to that in any forward area in previous campaigns in the Southwest Pacific. Evacuation of the wounded was accomplished much more quickly and with greater ease. The proportion of patients that had to be operated upon in the portable surgical hospitals was greatly reduced. Not only were a greater proportion of the wounded operated upon in the field and evacuation hospitals, but certain of these hospitals were designated to care for special types of wounded for which they were particularly qualified. Head injuries, maxillofacial wounds, and others were thus given definitive treatment by specialty groups. These hospitals were located in permanent build-

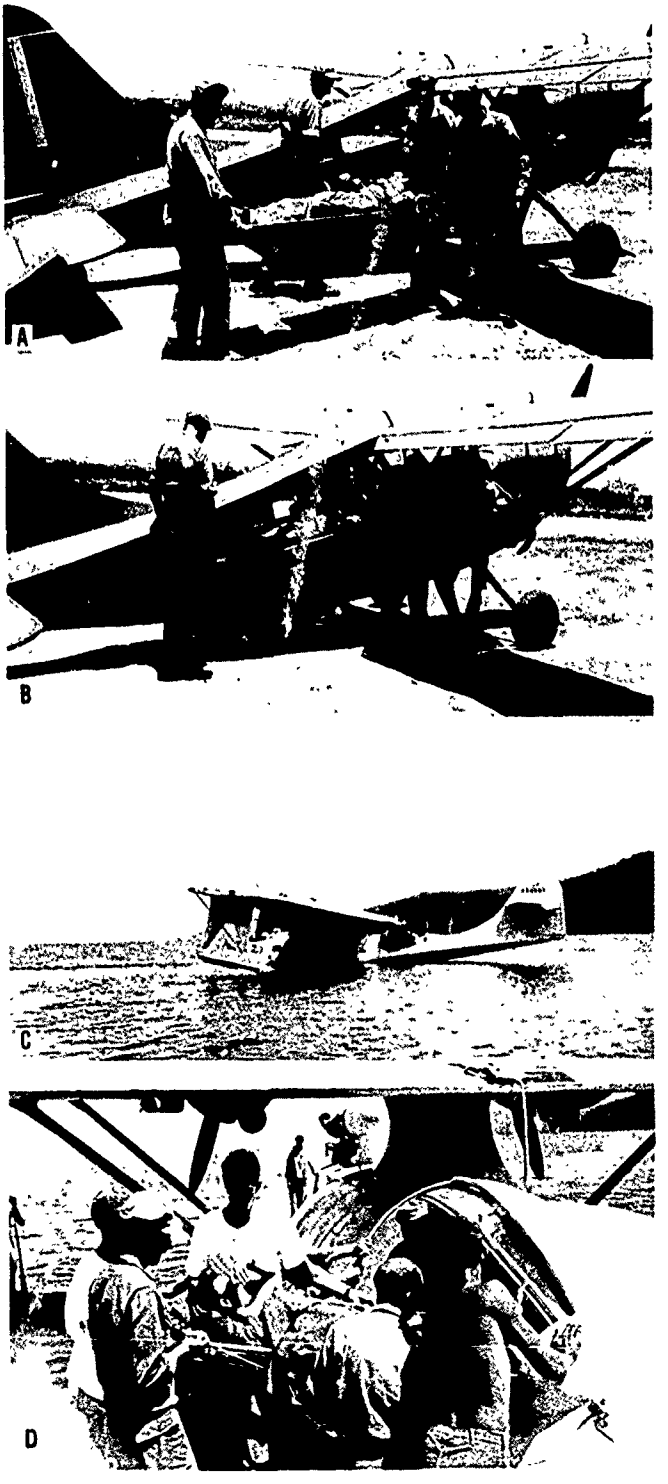


FIGURE 86. *(See opposite page for legends.)*

ings, such as schoolhouses and churches, and could be expanded easily. Thus, the need for evacuation to the rear bases was rendered less acute than it had been on Leyte where tentage was at a premium.

The reduction of the time lapse between wounding and definitive surgery diminished the incidence of severe wound infection. For example, gas gangrene was infrequent on Luzon as compared with the Leyte campaign in which almost 100 cases developed among approximately 9,000 casualties, whereas there were less than half that number in some 27,000 casualties on Luzon (p. 494). That patients with abdominal wounds did not have to be evacuated to far-removed bases and could be left unmolested for from 10 days to 2 weeks after operation undoubtedly decreased the mortality for that group.

The value of adequate whole blood from the United States in the treatment of the seriously wounded could not be overemphasized. In the seriously wounded and partially exsanguinated, to be able to replace large blood loss without stint and to be able to follow resuscitation with early superior surgery was gratifying. The daily distribution of blood to field and evacuation hospitals provided a source of whole blood for the more forward units even to the battalion aid stations where it could and should have been used. Approximately 20,000 units of blood were used on Luzon during the first quarter of 1945 by the Sixth U.S. Army.

SUPPORTIVE THERAPY

Plasma and Whole Blood

During the first half of 1944, as one made rounds on surgical wards in the most forward medical units as well as in those of the hospitals in the rear bases, it was quite evident that more blood was needed for the wounded. Hemoglobin values and red blood cell counts were too low. In the forward areas, plasma was used in great quantities in the resuscitation of the wounded. It gave volume to the circulating medium, but it did not increase oxygen-carrying capacity. Blood was used too infrequently and in too small amounts. The source of fresh whole blood was limited to medical unit personnel and whatever troops might be nearby. Many of the men had had malaria so that this hazard was ever present. Facilities and equipment for processing blood for transfusions in the New Guinea jungle were more limited than in civilian hospitals back home, and the incidence of transfusion reactions was consequently higher. There were units whose professional personnel were limited in their experience with transfusions, and as a result they were easily discouraged and instead of seeking out the cause of the reactions took refuge in the erroneous conclusion that transfusion reactions were unavoidable in the tropics.

FIGURE 86.—Air evacuation on Luzon Island, Philippine Islands. A and B. Evacuation by L–5 aircraft. C. Catalina flying boat standing by for wounded. D. Casualty on Stokes litter being loaded into Catalina flying boat for evacuation to Manila.

The patients evacuated from the forward area to the rear hospitals too often had a low serum protein level as well as reduced hemoglobin and red cell count. It was the repeated experience of the consultant after making ward rounds in these hospitals to insist that more transfusions be given and then to hear the various reasons why they were not given. The answer rested in the fact that an adequate supply of satisfactory, preserved whole blood was not available. This was the state of affairs despite the fact that a highly efficient and scientifically controlled Australian blood bank in Sydney, a combined Australian Army Medical Corps and Australian Red Cross Society organization, furnished blood for American units in New Guinea. Citrated whole blood packed in insulated and iced boxes were sent from Sydney to New Guinea where it was re-iced or kept in refrigerators until used. This was not satisfactory because there were many instances of excessive hemolysis, fibrin clots, and reactions. These all contributed to a general lack of confidence in preserved whole blood and the tendency to further popularize plasma.

When the SWPA was extended into Netherlands New Guinea and Hollandia became the main base, because of both the distance and unsatisfactory experience with the citrated refrigerated blood from Australia, it was decided to establish a blood bank. The U.S. Navy had had in operation for some time a blood bank on the LST (landing ship, tank) 464, and, in cooperation with Army units, blood was taken from troops, processed, and sent forward. With the same processing, a blood bank was established at the 27th General Hospital in Hollandia. Working in conjunction with the LST 464, this blood bank provided the greatest amount of citrated blood ever to accompany a task force up to that time in the SWPA; namely, the invasion of the Philippines at Leyte. This was a step forward to correct the inadequate supply and use of whole blood, in particular, in the care of the freshly wounded, but left considerable to be desired. There were still too many reactions. There was some breakage and also excessive hemolysis. Fibrin clots caused difficulty in administration.

On 23 November 1944, the first citrated blood provided by the American Red Cross was flown by C–54 to Leyte from the United States by way of Hawaii and Guam. Lieutenant Lake and Lieutenant Hendrick of the U.S. Navy, representing the Red Cross, accompanied the shipment of blood consisting of 64 bottles contained in 4 regular containers. These were used in medical units under control of the Sixth U.S. Army. This well-processed blood in containers equipped with adequate filters and individual sterile sets for administration immediately answered the common objections to giving transfusions. No longer was it necessary to call on troops staging for missions to give blood, processing setups were no longer needed, and the preparation of equipment for administration was obviated. Furthermore, the container for transporting the blood was well constructed and efficient. The unit containing 16 bottles was ideal for sending to the smallest units doing definitive surgery. The blood arrived on Leyte from San Francisco in from 5 to 7 days. This adequate supply of whole blood that was made available for the wounded soldier

was one of the great accomplishments in the war. In due course a distribution system was established that provided a daily supply to field and evacuation hospitals. The ambulances and small planes evacuating patients from clearing companies and portable surgical hospitals transported blood forward. The use of large quantities of whole blood where severe hemorrhage had occurred did without doubt contribute to the saving of lives in the forward area that would otherwise have been lost. As much as 4,000 cc. per wounded soldier were used within the first 24 hours of wounding. When such quantities were indicated, one transfusion alone was of little avail. With adequate blood available, exsanguinating hemorrhage and shock were much better treated immediately, and the general appearance of the more seriously wounded greatly improved. The proof that the product and equipment supplied was excellent was demonstrated by the results. One evacuation hospital gave 720 units of blood in one month without a single serious reaction.

Throughout the Luzon campaign, the blood supply from the States was well maintained and it was possible to set 4,000,000 RBC as a minimal level for all patients.

Chemotherapeutic Agents

The use of sulfonamides locally as a first aid procedure in the treatment of the wounded was described in basic War Department Field Manual (FM) 21–11, First Aid for Soldiers.

It was the observation of the surgical consultant that no other one procedure was followed so uniformly as the local application of sulfonamide powder to wounds in fresh battle casualties. It was applied by the aidman, and the soldier was well aware of the possible benefits of such chemotherapy. To that extent, it was a valuable moral therapeutic adjunct in his care. The use of sulfonamides locally during and following definitive treatment of wounds was likewise uniformly employed in the various surgical units of the forward area as late as the early part of 1943. Inadequate debridement was followed by the application of sulfonamide powder locally, and in many instances it was accompanied by the sense of false security on the part of the surgeon. On surgical rounds, one would occasionally see wounds that had been incised to various degrees and filled with sulfonamide powder that acted as a foreign body. It was common practice, following a well-done debridement, for the surgeon to sprinkle various amounts of sulfonamide powder into the depths of the wound. In exploration of the abdomen where no perforation of the viscera was encountered it was not unusual to see a surgeon sprinkle sulfonamide powder in a clean wound. On direct questioning as to what was being accomplished by such use of sulfonamides, there were many replies indicating that they believed it was of great chemotherapeutic value, that it prevented infection if it was not already present, that its use in clean wounds was justified in the tropics on the basis of preventing infection, and that it accelerated wound healing.

Although there was considerable literature before 1942 which demonstrated the limited effective use of sulfonamides in infection, demonstrated that there was considerable foreign body reaction where sulfonamide was placed in the wound locally, and explained that the local use of sulfonamides inhibited wound healing and certainly did not accelerate it, these facts were not well known. Reports in publications by the Army and Navy, recording in glowing terms the prophylactic use of sulfonamides at the Pearl Harbor disaster, also gave a great number of medical officers a sense of false security. Medical officers not well trained in basic principles of surgery were inclined to do minimal surgery and then apply sulfonamide powder in or on the wound.

When penicillin was made available to medical units in the forward area in March 1944, the assistant surgical consultant of the SWPA had an opportunity to discuss with a large number of medical officers their conception of wound infection and the mechanism of wound prophylaxis by means of chemotherapeutic agents. Too frequently, there was a lack of understanding that in the prevention of wound infection one of the most important requirements was the removal of devitalized tissue and the prevention of the extension of infection by providing adequate drainage. The impression did exist that sulfonamide placed on a wound superficially penetrated into its depths. That the pouring out of exudate from traumatized tissue mechanically moved the sulfonamide from where it would have been efficacious in inhibiting growth seemed to have been forgotten. The complications of the systemic use of the sulfonamides were not well appreciated, and serious complication occurred as a result of sulfonamide therapy plus dehydration. Directives were published by the army surgeon's office cautioning the use of these drugs systemically and outlining a course that provided for adequate fluid intake and alkalinization.

An attempt was made to discourage the use of the sulfonamides locally following definitive surgery in the hope that there would be more attention given to complete and adequate surgery including the removal of devitalized tissue and providing for complete and free drainage.

If, in the opinion of the surgeon, sulfonamide therapy was indicated, then it was recommended that surgeons watch the patient's fluid intake and check at frequent intervals the blood and urine in an effort to discover early any untoward complications of these groups of drugs. It was pointed out early in 1944 in a directive from the army surgeon's office that the use of sulfonamide was not obligatory. A few months later, it was recommended that the existing liberal local use of sulfonamide therapy be curtailed. Late in 1944, the surgical consultant of the Sixth U.S. Army recommended that local sufonamide therapy be discontinued and that only systemic therapy be used on cases in which it was clearly indicated. In spite of the efforts of educational measures taken, a large number of medical officers continued to use sulfonamides locally in wounds. Those most convinced of its worth and most insistent on its merit were those who had recently arrived from the Zone of Interior. The publicatin of War Department Technical Bulletin (TB Med) 147, in March 1945,

should have settled the problem which had been controversial since the reports, in January and February 1942, of the Pearl Harbor disaster.

SURGERY OF REGIONAL WOUNDS AND INJURIES

Neurological Injuries

Casualties having head wounds with brain injury were evacuated, when possible, to designated field and evacuation hospitals for definitive treatment. During the various actions in New Guinea, there were many instances when this was impractical and definitive surgical treatment had to be done in portable surgical hospitals. For the most part, these patients withstood transportation well. Extensive, time-consuming procedures were sometimes required in massive injuries, and, thus, a small number of patients would keep a neurosurgeon busy. Too few trained neurosurgeons were in the forward area, and there were times when neurosurgical teams could have been well used. Large defects of the dura were closed with fascia and sliding scalp flaps. Damaged brain tissue and foreign bodies when accessible were removed. Fibrin foam was first available in early 1945 and proved to be of great value in the control of bleeding.

The postoperative care of these patients during the early phases of an action and before Army Nurse Corps members arrived presented a real problem. Nurses trained in the care of postoperative neurosurgical patients were invaluable and second in importance only to the surgeon in the most seriously injured head cases. Both in New Guinea and on Leyte, lack of neurosurgeons and facilities for special nursing care limited the attention accorded these patients. On the other hand, on Luzon, both were available, and care given there was superior in every way.

Spinal cord injuries due to intact missiles and shell fragments were occasionally subjected to laminectomy and exploration during the fighting in New Guinea. The results led to almost complete abandonment of this procedure. Following preliminary treatment including careful suprapubic drainage established by placing a well-fitting mushroom catheter in the dome of the bladder, these patients were given a high priority for evacuation to rear bases. They were transported in complete body spicas. Limited nursing facilities, cots, plaster spicas, and long distances from the rear area were factors that contributed to the large decubitus ulcers so common to those with cord injury.

Peripheral nerve injuries were rarely repaired. The ends of divided nerves were frequently marked by placing a suture of black silk or a silver clip in the divided ends.

Thoracic Injuries

The closure of open chest wounds in battalion aid stations and clearing stations was well done by strapping with adhesive tape and massive dressings. Large wounds and those associated with severe hemorrhage did poorly; lesser wounds did well. These patients likewise tolerated transportation if hemor-

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rhage was not great. Where circumstances required that these patients be cared for in a portable surgical hospital without intratracheal closed system anesthesia, operative procedures were limited. Local anesthesia and major chest surgery were not compatible; open anesthesia could be dangerous indeed. When possible, all major chest injuries were cared for in designated evacuation hospitals where those with both experience and equipment were available. Hemorrhaging wounds had to be controlled by the simplest procedure in the forward area. Sometimes, there was a tendency to do too much following the success of the control of blood loss.

Perhaps in no other group was fresh whole blood more important than in massive chest wounds where there had been large blood loss. This with oxygen therapy was found to be lifesaving and was followed by successful resuscitation. It was found that preserved whole blood, such as that received from the States or rear blood banks, had a reduced oxygen-carrying capacity and, although better than plasma, could readily overload the circulation.

The closed treatment of pneumothorax and hemothorax by early aspiration was in general followed. This practice, together with penicillin therapy, proved very satisfactory. While the later incidence of empyema in patients thus treated was not known, by far the great majority of these patients ran an afebrile course prior to evacuation or discharge.

Abdominal Injuries

During the Leyte campaign, approximately one-half of those with abdominal wounds were operated upon in portable surgical hospitals, and the remainder were operated upon in surgical units of larger size, such as field and evacuation hospitals. Those operations that were done in the portable surgical hospitals were sometimes delayed for as long as 18 hours after wounding because these hospitals were most forward and isolated. During the first part of the campaign, plasma was used to bolster these patients on their way from the battalion aid stations to the hospital where definitive surgery was to be done. After the inauguration of the delivery of blood from the United States, it was possible to use more whole blood during this critical phase for those who were partially exsanguinated.

Here again, whole blood was of great benefit to resuscitation. The period required for retrieving a patient from shock and reestablishing his vital processes so that he could withstand the added burden of operation was reduced. Experienced surgeons appreciated the importance of this preoperative phase, and for the most part the wounded were well prepared for operation.

Anesthesia employed on abdominal cases in the portable surgical hospitals was usually open-mask ether. Because the simple abdominal injury was associated frequently with injuries to the diaphragm or chest, one of the shortcomings of the portable surgical hospital was inadequate anesthesia. For abdominal injuries, open-mask ether was adequate, but it was not suitable for open chest operations. In field and evacuation hospitals, machines were

available and intratracheal tubes were placed before operation was begun. Local and spinal anesthesia was discouraged and little used. The evacuation of gastric contents before beginning an anesthesia was routine practice.

Abdominal wounds required a definite pattern or preoperative examination and preparation. The following procedure was followed: Complete physical examination in an attempt to determine site of entrance and exit of the missile, X-ray examination to determine the presence or absence of shell fragment or intra-abdominal air, neurological examination of the lower extremities to reveal absence of nerve or cord injury, and catheterization to establish integrity of the bladder wall. Carrying out these procedures preoperatively reduced the time consumed in determining them later during the operation.

The exploration of the abdomen of the battle casualty required ingenuity. Large abdominal defects sometimes dictated the type of incision. The smaller wounds, and these might be associated with the most extensive abdominal injuries, were best explored by an adequate incision—midline, midrectus, or transverse. Observation of the difficulties that operating surgeons encountered showed that inadequate exposure accounted for many, as did also lack of a routine for exploring the abdominal contents. Occasional injuries of the large bowel, in particular in the distal portion, were overlooked. Then too, wounds of the pelvis involving the rectum required continual vigilance. The treatment of defects of the large bowel and rectum by those new to forward area surgery often demanded close supervision.

The objective of saving life with the minimal risk and not attempting to determine what might be survived or tolerated had to be kept foremost in the surgeon's perspective. Post mortem examinations were all important for this purpose. Many surgeons found it extremely difficult to follow the instructions of exteriorization of the large bowel or complete deflection of the fecal stream by an adequate colostomy. Nevertheless, after a period of experience, surgeons accepted the policies which had been laid down in an attempt to guide them from these common pitfalls. In the reconstruction of the continuity of the intestinal tract, many surgeons insisted on using a side-to-side anastomosis, whereas an end-to-end, had they been familiar with it, could have been accomplished more quickly and would have given a better physiological result. Liver injuries combined with large bowel injuries had the highest mortality rate. Liver injuries alone likewise were dangerous. Drainage of these wounds to the exterior was accomplished with a more favorable result. Injuries of the stomach and small intestines unassociated with large bowel injuries had an incidence of recovery of upwards of 85 percent. The use of the Wangensteen tube or the Miller-Abbott tube postoperatively did a great deal to prevent abdominal distention and vomiting. The placing of these tubes postoperatively in all abdominal cases was routine.

Wound disruption was a complication that could have been greatly diminished. Abdominal closures ordinarily were made with catgut, silk, or cotton. Catgut layer closure was probably most frequently used. Grossly contam-

inated abdominal wounds were very prone to infection and dehiscence. Through-and-through suture material—silver wire, gage 12, without closure of the skin—proved most satisfactory, whereas through-and-through silk (number 14 or braided) and plastic suture material (such as Dermalon) or silkworm gut were very inefficient. Abdominal wounds in which the skin was left open with petrolatum-impregnated gauze placed in the subcutaneous tissue had an opportunity to drain if infected and were undoubtedly a means of reducing the incidence of wound disruption. It would be highly desirable to furnish all forward units in the future with adequate amounts of soft silver wire, 12 gage, with atraumatic needles to place these sutures.

The greatest surgical heartbreak in World War II was the result of moving patients with intra-abdominal injuries too soon after operation. The experience of World War I had recorded this fact well. The various directives and instruction sheets dwelt upon it. Nevertheless, because of the nature of the fighting in New Guinea and on Leyte and, to a lesser extent, on Luzon, patients were brought into forward units where they could not be evacuated, sometimes for from 12 to 18 hours. The surgeons there viewing the situation as they saw it, and not without some justification, operated upon these patients whose postoperative course would be satisfactory. Then, for one of a number of reasons, the patient would be moved. The tactical situation might be the reason, or more space might be required. The reason was immaterial to the end result; the fact remained that abdominal patients moved within the first 10 days of operation developed a high incidence of complications and that many of them were fatal. This fact was more evident to the consultant than to anyone else, and at his insistence the Surgeon, Sixth U.S. Army, brought into action in the Luzon campaign ways and means that reduced to a minimum the moving of abdominal patients so soon after operation.

Injuries of the Extremities

Approximately two-thirds of all injuries occurred in the extremities. For the purpose of discussing the experience of treating these injuries in the forward area, they may be divided into two groups, those involving soft tissue only and those involving soft tissue and bone. The goal in the care of these cases was to save life, save limb, and preserve function insofar as possible.

All wounds occurring in the forward area, whether from the intact missiles or shell fragments, required adequate exposure of the missile track in order that devitalized tissue could be observed and that it might be ascertained that blood vessels supplying the structures in that area were intact. If adequate exposure was accomplished by long linear incisions, muscle groups separated to expose injured tissue, and injured tissue removed, and, at the same time, if the blood vessels were examined and, if injured, ligated, there were few later complications due to infection and hemorrhage. The term "debridement" was grossly misconstrued. The wounds of a bullet, entrance and exit,

were sometimes said to be debrided when only a circular bit of skin was removed from the skin margin. The one procedure that, in the consultant's eyes, labeled a surgeon as being inadequate was to practice the circular incision of the skin about the bullet wound and sprinkle sulfonamide powder about it considering he had surgically treated the wound.

Long linear decompressant incisions that exposed the missile track, followed by the removal of damaged tissue and the placing of a single sheet of petrolatum-impregnated gauze, established conditions that made anaerobic growth improbable and ordinary infection rare. The period of disability observed in the forward area from bold incisions was minimum. Wounds were approached from the wound of entrance or exit down to the depths. The exploration of blood vessels within a wound was continually stressed. Hematoma in the region of the blood vessel invariably meant hemorrhage from one of the main vessels or a tributary. Patients in shock with lowered blood pressure would cease to hemorrhage, a clot would form, and, later, with a reestablished normal blood pressure or manipulation and, sometimes, infection, renewed hemorrhage would take place. Repair of blood vessels either by suture of a defect or by an anastomosis was unsatisfactory and not employed; rather, the blood vessel was ligated. Ligation of large vessels, such as the femoral or popliteal, which jeopardized the distal circulation were given the benefit of sympathetic block.

The immobilization of soft-tissue wounds was insisted upon. Through-and-through bullet wounds that had been explored through adequate incision were immobilized in plaster just as routinely as were the massive soft-tissue wounds. In some of the evacuation and station hospitals that served as general hospitals in the forward area, early delayed closure was practiced as well as early skin graft. Both procedures were to be recommended and were not utilized as fully as they might have been. Soft-tissue wounds exhibiting considerable tissue damage were placed on penicillin therapy for from 8 to 10 days. Where the wounds were received late and the likelihood of anaerobic as well as aerobic bacterial growth was evident, sulfonamides were used systemically. Soft-tissue wounds of the thigh and buttocks, associated with injury to the pelvis and its contents, the bladder, the bowel, and the rectum, necessitated radical incision in an effort to prevent extension of infection, or to combat it, if already existing. Wounds of the upper thigh have been given inadequate attention chiefly because of the failure to recognize that many of these wounds involved intraperitoneal damage. Wounds involving all joints and, in particular, wounds of the elbow and knee required incision with decompression of fascia overlying adjacent muscle groups as well as exposure of blood vessels that may be the source of expanding hematoma. The optimum position of any soft-tissue wound is one that provides for the least restriction of circulation.

In the battalion aid station, hemorrhage was controlled, dressings and splints were applied, sedation for the control of pain was administered, prophylactic chemotherapy was instituted, and patients were resuscitated from

shock if time permitted. Definitive surgery for injuries involving bone began with the unit that could accomplish satisfactory treatment of the soft-tissue wound and completely immobilize bone fragments. The only satisfactory method of immobilization in forward area installations was the application of plaster cast. Immobilization rather than reduction of displaced fragments was adhered to when the patient was treated in portable, field, or evacuation hospitals. The transportation of compound fractures in plaster casts was associated with an extremely low incidence of complications. If a wound had been well decompressed, and in the majority of compound fractures the injury had already established this, immobilization in plaster rarely if ever interfered with the circulation. In the field and evacuation hospitals where X-rays were available, alinement of fragments was satisfactorily done. There were times, it was true, when the ideal position was not obtained; however, it was expected that within 2 or 3 weeks from the time of wounding the patient could be transported to installations where additional procedures could be undertaken to accomplish this. Internal fixation and traction were not employed in forward area installations. Only occasionally was open reduction of a fracture done to replace a fragment that jeopardized the circulation or nerve supply of an extremity. Too few surgeons arriving in the forward area had had adequate training in the use of plaster. The best quality of plaster of paris, adequate training in its use, and continual stimulation to develop better methods of securing strength with less bulk is to be encouraged in the future. The use of plaster was not the restricted domain of the orthopedic surgeon, and general surgeons should have been masters in its use. The supply of plaster frequently ran low during the early days of an action. Units accompanying combat groups should have carried large supplies of plaster and the necessary cotton batting to go with it.

The principle of guillotine amputation at the lowest level of viable tissue was closely followed, but only by insistence and repeated admonition was skin traction maintained. The use of skin traction by stockinet and skin adherent was very effective in reducing the healing time of the stump, provided that elastic traction was maintained with proper adjustment.

In the immobilization of fractures for transportation, there were certain tendencies that were common in all groups. The first was the hesitancy to use the plaster spica of insufficient extent to completely immobilize the part involved. In the transportation of patients by plane, in particular in plaster spica, exaggerated abduction made handling of the patient extremely difficult. Although ideal position could not be obtained always, the degree of abduction should be maintained at a minimum. Immobilization of a knee joint necessitates the immobilization of the joint above and below. This required repeated emphasis. The shoulder spica was of great importance in the evacuation of patients over long distances. Such casts required care in application in order that they fit well and that they be strong enough not to give way. A

broken plaster shoulder spica was dangerous. Only rarely were hanging casts used on patients in the forward area who were to be evacuated.

Burns

With the invasion of Leyte, suicide bombings began to produce a large number of burned patients. Many ships were hit in the harbor, and, if a large number of personnel were aboard, the resulting casualties were likewise great. The majority of these men suffered burns with or without other injuries. In some instances, the total number of wounded removed from a single liberty ship was 80. These patients were treated on LST's fitted out as hospital ships and operated by the Navy, and by shore medical units of the Army. The treatment of large numbers of burned patients became rather standardized during the 8 weeks that the Sixth U.S. Army was on Leyte. Patients were given morphine before they were removed from the ship and then transferred by litter to wherever they were to receive further treatment. Here, all clothing was cut away. Those with burns only were separated from those who had complicating injuries or other injuries or both. Debris and detached skin were removed, and the burned surfaces were covered with 12-inch squares of petrolatum-impregnated gauze. Over this was placed gauze waste or Dakin's padding reinforced with bandage. Over this was placed stockinet. This did not constitute a pressure dressing; rather, it was a petrolatum dressing on the burn surface so reinforced as to hold it in place. Patients received plasma while dressings were being applied. Patients with massive burns were followed closely with hematocrit, and the reading was used as the criteria for the amount of plasma to be given. When protein (serum) determinations could be made with the copper sulfate method, this was used. The local treatment of the burns consisted of using petrolatum-impregnated gauze and preventing, insofar as possible, further injury and contamination. Initial drug therapy for preventing infection was limited to penicillin—120,000 units per 24 hours. Original dressings, if expertly applied, could well be left unmolested for several days. The control of infection varied, and later sulfonamides were sometimes employed, in particular sulfadiazine, adequate attention being given to alkalization and water balance.

The treatment of patients with severe burns and injuries from bomb fragments presented complicated problems that required every ingenuity. The mortality rate was high. For example, after a suicide plane hit one ship, 21 of the ship's personnel were killed, 26 were both wounded and burned, 12 were wounded only, and 8 died within 24 hours.

Patients with wounds and extensive burns were difficult problems. The general plan was to treat shock with morphine, plasma, and transfusions. Thereafter the surgical procedure, as indicated, was followed. Burns were treated as early as possible, but there was of necessity considerable variation in therapy.

TROPICAL JUNGLE FOOT

Approximately 120 patients were admitted to two evacuation hospitals on the island of Leyte on 23 November 1944 because of swollen, painful feet, the skin of which showed various degrees of ulceration. These soldiers had all been through a similar experience. They had been under combat conditions on the frontline. Typhoons and rain had been almost continuous. They had been in foxholes and crawling through the jungle for a period of from 9 to 17 days. During this time, they had rarely removed their shoes. There were no dry socks or footwear to change to. A majority of the patients said that after being under this condition for from 4 to 7 days they began to have burning sensations, first on the dorsum of the feet and then on the toes and soles.

At first, moving about gave them some relief. This was soon lost, however, and walking became increasingly painful. When they removed their shoes, their feet appeared swollen and quite pale. If the shoes were left off, the feet became flushed and warm, burned, and developed a tingling sensation that was quite painful. Elevating the feet gave some relief. If the shoes were left off for a half an hour or more the feet became so swollen that shoes could scarcely be replaced. In this early phase, the feet showed no areas of loss of skin or ulceration. As time went on under these conditions, the feet became more swollen and painful with ulcerations appearing first on the dorsum, then about the toes, and rarely on the soles, although cracks in the skin of the soles did appear. Because of pain, walking became impossible. Many of these patients had been in an isolated group. When relief came, they were carried by litter through swamp and over difficult terrain that they could not have traversed themselves. It was estimated by these troops that almost 50 percent of their group suffered similar foot disabilities. Two soldiers volunteered the information that their feet did fairly well as long as they could take their shoes off at night but that, when this was not possible, disabling symptoms developed rapidly.

The findings on examination of these patients were remarkably similar and varied only in degree. They had been in the hospital less than 12 hours when examined by the army surgical consultant. All were fatigued, but only rarely did they seem to be resting. They assumed different positions; some lay with their feet elevated, others sat with their feet on the cots, still others clasped their ankles and lower legs, and some let their feet dangle. They tended to shift from one position to another. The most common complaint was a burning sensation of the dorsum and soles with a "deep ache." An attempt to stand on the feet was accompanied by a look of helplessness and distress as well as pain. On walking, they moved with hesitant deliberation, slowly increasing the body weight on the foot after putting it down. They reminded one of a cat walking on fly paper. Washing with cool water and a

little soap gave momentary relief and then as the skin dried the discomfort returned. Socks and dressings were intolerable.

There was considerable variation in the appearance of the feet of these patients; with rare exception, there was a marked to an intense erythema, while swelling made the soles bulge and the skin of the dorsum tense and shining. There were frequently blebs and ulcerations with weeping serum at the base of and between the toes. The distal portions of the toes were sometimes blue, white, mottled, and cold. In many, there was a swollen erythematous appearance of the remainder of the foot. After the feet had been washed with soap and water and the skin had been allowed to dry, the involved skin could be seen to be well demarcated at the shoe tops. There was edema below this level but rarely above it. There were scattered areas of ecchymosis in the patients showing greatest involvement. Pulses were not obliterated in any of the feet examined and the variation was within the normal range. Blushing on pressure was slow, likewise the return flush.

The ulcerations of the skin likewise varied a great deal, being most numerous over the dorsum and toes. These were almost blotchy in appearance, giving the impression that they had been produced by abrasion and pressure, except for the fact that in some the superficial layers of skin had been lost and in others the destruction extended down to and through the true skin. Some of the ulcerations were well demarcated with a small zone of necrotic skin along the margin, giving the appearance of decubitus ulcer or gangrene. The skin between the ulcers, especially over the dorsum, was pale, cold, and inert. The erythematous areas did not readily blanch on pressure which caused pain.

Systemic reactions were lacking, except fatigue from inability to sleep. Temperature, like pulse rates, was within normal range. There was a striking lack of secondary infection in the ulcerated areas. Only a few patients who had had previous troubles, such as epidermophytosis, exhibited any evidence of tubular lymphangitis. Approximately 15 percent admitted some discomfort in the groins on direct question; all of these had enlarged and sensitive lymph glands. There did not appear to be any parallelism between the swelling and pain of the feet and the lymphadenopathy.

Sensory changes were indistinct. Areas of numbness and tingling could be demonstrated by light touch and pinprick, and yet pressure was painful. Elevation of the feet seemed to increase the areas of diminished sensation. In general, attempts to outline the areas of paresthesia and anesthesia were unsatisfactory because of the discomfort and fatigue of the patients.

The treatment of these patients consisted first in general supportive measures. Shoes were removed, socks cut off, and the feet bathed in cool water with white soap. This gave considerable immediate relief but was of short duration. If the feet remained in the water longer than 10 or 15 minutes,

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the burning and tingling increased, as it did when they were removed from the water and allowed to dry. The absence of a dressing, or the application of a light dry dressing, seemed to give some slight relief. Mineral oil was not well tolerated, and lanolin was not used. Various sedatives were employed to give rest. The patients were kept off their feet insofar as this was possible in a crowded forward hospital. The majority of the patients were evacuated by ship within 36 hours.

Contrary to the course of patients suffering with the usual trenchfoot or immersion foot, these patients recovered relatively rapidly from the local swelling, excoriation, and infection, and also from the vasomotor manifestations of discoloration and pain. They were greatly improved within 4 or 5 days after hospitalization.

A followup study of these cases was made. Sympathetic block was done on a few of the patients with some improvement of symptoms, but few or no objective changes were observed. It was reported from a rear base, where these patients arrived some 10 days later, that they were almost symptom free and had evidently recovered rapidly.

GAS GANGRENE

Before the Leyte campaign, reports made by medical units in the forward Sixth U.S. Army area showed 24 cases of gas gangrene during 1944. Forty-seven cases of clinically diagnosed gas gangrene occurred during the 65-day period that the Sixth U.S. Army was on Leyte. The 47 cases developed from 8,893 battle casualties and were of a fulminating type. Whereas the mortality rate for the group of 24 was less than 10 percent, in the 47 it was over 30 percent. The onsets of symptoms and signs were sudden and dramatic, the virulent infection sometimes appearing within 24 hours of wounding. A very probable explanation of the sudden increase was in the fact that most of the fighting on Leyte took place in the ricefields that were fertilized by the "night soil" in thickly populated areas, an ideal source of the clostridia. In addition, 45 cases developed in patients evacuated to rear bases. The total number of deaths following gas gangrene in the 92 patients was 29, a mortality rate of 31.4 percent.

In contrast was the experience in the Luzon campaign where, in over twice the number of wounded, there were only 30 patients who developed gas gangrene during the months of January, February, March, and April. The mortality rate was 16.6 percent. The difference in these last two groups was caused by many factors, which can best be summed up as follows: On Luzon, conditions permitted the earlier and more satisfactory treatment of the wounded, and the weather and bacterial flora of the land where the fighting took place did not result in such a high degree of contamination of the wounds with *Clostridium welchii* or other anaerobes.

TETANUS [1]

As Constultant in Surgery, Sixth U.S. Army, Colonel Glenn had an opportunity to observe many of the civilian wounded in Manila. The medical importance of the high incidence and severity of tetanus then appearing was evident early, and the collection of information and data about such patients was begun. The civilian hospitals, operating under combat and siege conditions which prevented the preparation and accumulation of detailed records, were aided by army personnel, and one civilian hospital—the San Lazaro Hospital—was operated directly by representatives of the Surgeon, Sixth U.S. Army, for a few weeks after American troops entered Manila. The account of the observations concerning the care of civilian battle casualties who developed tetanus represents information collected from all possible sources.

In order that the unusual background that provided such optimum conditions for the development of tetanus may be kept in mind, it is necessary to review some of the circumstances then existing. A city that is held and defended by one military force and attacked by another from the air and ground as well as by a not far off naval force soon becomes a place where the care of the wounded and sick is difficult indeed. Manila was such a place in February and March of 1945. The inhabitants could not flee the city; they were subjected to the action of Japanese military force as well as to the fire from the American elements besieging the city. The civilian population long had been on a limited diet, and this was markedly curtailed with the onset of active fighting. The wounded—victims of air bombing, artillery fire and small arms, hand grenades, and bayonets and swords of the Japanese—steadily accumulated. The casualties were taken by relatives, friends, or bystanders to the hospitals. These institutions were also casualties—some had sustained direct hits; personnel had been depleted in some instances by enemy action, in other instances by urgent demands to administer to those outside the hospitals; some in attempting to protect their families had been cut off from returning, others had been commandeered by the Japanese. The result was that only a token number of the hospital personnel were in these hospitals and, under the prevailing confusion, organization did not exist. The water supply was cut off early, the sewage systems became blocked, and the food supply was further limited, as it had been for some time before, and very quickly became almost negligible. The civilian hospitals were overfilled with the wounded, the dying, and the dead.

In the San Lazaro Hospital a few days after the beginning of the battle for Manila, there were approximately 1,300 civilian patients, and over 1,100 of these had been wounded. From this group, 156 cases of tetanus developed. The picture of this hospital was a most unhappy one—it was overcrowded, all beds and all floor space were filled with the wounded, many dying, many dead.

[1] Glenn, Frank: Tetanus—A Preventable Disease. Ann. Surg. 6: 124, December 1946.

By and large, the dead had the most severe wounds of the head, thorax, and abdomen. However, among the living there were wounds of every part, approximately 70 percent involving one or more of the extremities. An occasional wound had been closed, but the majority had had no surgical care. Some wounds were covered with dressings of sorts consisting of parts of clothing. Bandages were few, and flies swarmed over the partially exposed wounds. Fractures of the extremities were splinted for the most part only by the pain that prevented patients from moving. The patients, children and adults, exhibited all phases of injury, exsanguination, shock, infection, and malnutrition.

The location of wounds in the 156 patients who developed tetanus was as follows:

Location of wound	*Number of wounds*
Head and face	20
Neck	1
Thorax	12
Abdomen and back	17
Buttocks	21
Pelvis	4
Upper extremities	34
Lower extremities	76
Burns and miscellaneous	21

There were many instances of multiple wounds. The number of patients with wounds of the head and neck who developed tetanus was small in comparison to those with wounds in other regions of the body. Compound comminuted fractures of the long bones associated with massive soft-tissue damage and extensive infection, on the other hand, seemed to be the type of wound most frequently associated with tetanus. Dependable and accurate data were seldom available as to the exact time of wounding and the onset of the symptoms of tetanus. It can be said with certainty that there were instances of tetanus being evident as early as 3 days and as late as 20 days from the date of injury. It may be estimated that 60 percent of the patients who developed unmistakable evidence of tetanus did so within 7 days.

The onset of symptoms was difficult to evaluate because of the general poor condition of these patients as described above. The vital processes were so depressed in the group and the clinical pictures so complicated by coexisting abnormal states and infections that they masked the classical early manifestations of the disease, such as the complaint of headache, stiffness of the neck muscles, and difficulty in chewing. Locked jaws were all too evident when fully developed, as were tetanic seizures and opisthotonos, and yet often these were the first manifestations of the disease to be observed. It should be stressed that the complaint of headache, stiffness of muscles, and pain in the region of the wounds could be elicited from the majority of the wounded.

Local tetanus was observed in the region of wounds and also in muscle groups proximal to the wound as well as in the muscle of the entire extremity.

Severe local tetanus associated with mild general tetanus was not uncommon, and muscle spasm, both tonic and clonic, was marked in the extremity where the wound was located. Usually, the wound was located in the distal portion, as on the forearm or hand of the upper extremity or on the leg or foot of the lower extremity. Local tetanus involving an extremity independent of the wound was not seen. However, one patient developed local tetanus in the stump of a mid-thigh amputation following removal of a gangrenous leg, the result of a compound fracture of the distal portion of the femur. Tetanus was not observed before the operation, and local tetanus was present on the following day. It persisted for almost 2 weeks and subsided. During this period, there was a slight trismus and almost no stiffness of the neck muscles.

The most frequently observed clinical picture was as follows: A patient with a wound of considerable extent in an extremity would be unable to open his mouth by 5 or 7 days after injury. There would be marked trismus and stiffness of the neck muscles. Associated with these two findings there would exist, or soon follow, mild spasms which fixed the head, body, and extremities in a straight line—orthotonos. Within a matter of hours as the seizures became more pronounced and more frequent, opisthotonos developed with greater involvement of the back muscles, so that during a spasm the back became arched and the body was truly supported by the head and heels. Concomitantly, there would appear the classical risus sardonicus with elevation of the eyebrows and retraction of the corners of the mouth, producing a grimace that exposed the locked jaws (fig. 87). Orthotonos was observed to be followed not only by opisthotonos but emprosthotonos. Spasm and rigidity of the abdominal muscles was an early and common finding that preceded generalized seizures and persisted during and between them. As spasms became more intense over a period of hours or days, they rendered breathing difficult. With the muscles of the neck and diaphragm and the intercostals in spasm, the air exchange was so reduced that the lips and nail beds became very cyanotic. During the severe spasms, there was profuse perspiration, and pain was excruciating and unbearable. As the disease progressed and the spasms increased in severity and frequency, the patient became physically exhausted but remained mentally clear and terrified. An occasional patient died during a spasm, but the majority, following complete exhaustion, became listless, and the diminishing convulsive seizures were followed by death.

Dysphagia was common and present in about 75 percent of all patients with tetanus, whereas trismus was more constant. A few (four) patients with a rapidly fulminating type of the disease did not exhibit trismus. The forearms and hands in the majority of tetanus patients were, in general, spared to a remarkable degree, so much so that even those with the most severe spasm could grasp the sides of the bed or cot during seizures.

The deep reflexes were early exaggerated, and the Babinski reflex was positive in approximately 20 percent of new cases. Ptosis of the eyelids was observed in seven instances in the 156 patients. Facial paralysis was seen only



FIGURE 87.—Patient, a Chinese, had been wounded in the hand by shell fragments and had active signs of tetanus upon admission to San Lazaro Hospital. Note the risus sardonicus.

once and no history could be obtained as to whether or not this was present before the onset of the disease. True cephalic tetanus as described in the literature was not observed. Extensor responses of the foot and leg on stimulation or during a convulsive seizure were common.

Those patients with generalized tetanus exhibited various degrees of urinary retention and, without exception, had difficulty in urinating. During a spasm, urine would be expelled in small amounts. Although a spastic vesical sphincter has been the cause commonly ascribed to this, no difficulty was encountered in catheterizing men or women. Spasm of the rectal sphincter was readily demonstrated early in generalized tetanus. Fecal impactions were rarely seen because the food intake of most of the patients had for some time been negligible.

The great variation of extent and severity of the wounds in such a group of civilian battle casualties with little or no previous primary surgical treatment offered some opportunity to evaluate late operative therapy. Those patients with well-established tetanus who could withstand operation, although improved by such therapy so far as sepsis and general condition were concerned, seemed to follow the common pattern of the disease and, with or without specific therapy, died. The incision and drainage of grossly infected wounds, the removal of foreign bodies and the accompanying manipulation, on the other hand, did not appear to increase the progress or severity of the disease. Furthermore, guillotine amputation for extensive injuries of the extremities

sometimes associated with gangrene and *Cl. welchii* infection did not appear to alter the course. However, it was significant that, in the group of almost 40 patients in the San Lazaro Hospital upon whom amputations were performed and who had no evidence of tetanus at the time of operation and no other wounds, only 3 developed tetanus; 2 of these died and 1 ran a course of 2 weeks and eventually recovered. As previously stated, extensive wounds of the extremities involving deep structures accounted for the greater number of patients with tetanus, although there were also many examples of those who had superficial wounds. Burns in particular, with or without additional injuries, led to tetanus, although somewhat later. In a group of 37 patients with severe burns, 10 developed tetanus 10 days or longer after injury. The course of the disease in these patients was apparently just as fulminating as in those who developed the disease with a shorter incubation period, and all ten died.

Penicillin was used in six patients with tetanus. Daily amounts of 200,000 units were given to five of these in 25,000-unit doses intramuscularly every 3 hours. There was no apparent effect upon the tetanus infection. The period of treatment was as follows: Two patients received penicillin for 6 days; one, for 5 days; one, for 2 days, and another for 36 hours. All of the six died. One child received a total of 1,200,000 units over a period of 48 hours, the initial dose being 25,000 units given intravenously and 50,000 units intramuscularly—this was repeated every 3 hours. Again, the terminal course was unaltered. Penicillin was used locally in two patients who developed tetanus following burns. The wounds were grossly infected, and penicillin was applied in strengths of 500 units per cc. without evident improvement.

In the last 3 weeks of February at the San Lazaro Hospital, 140 patients in the group of 156 with tetanus died, a mortality rate of almost 90 percent. That death was due to tetanus alone cannot be said because of coexisting conditions and other infections. There was little tetanus antitoxin for specific treatment. The facilities for general supportive treatment were also limited, and sometimes even the most simple patient care was lacking. Many patients died within a few hours after the appearance of the symptoms of tetanus, but many more lived for from 3 to 10 days.

The single most important item available was morphine. This drug in .008-gram doses reduced the duration and the severity of the spasms. It gave the patient rest and enabled those with dysphagia to swallow liquids that otherwise could not have been administered. Morphine given as indicated, sometimes as often as every 2 hours, did repress respirations, but it was the most useful of the drugs available and it is doubtful that pulmonary complications were increased by its use. Atropine, .0005 gram, given with morphine definitely improved respirations in severe spasms with marked opisthotonos.

Paraldehyde and chloral hydrate by rectum were well tolerated and effectual in a limited degree. The various barbiturates available were of minimal value. Severe and devastating generalized seizures were sometimes controlled

by using chloroform or ether or both as a general anesthesia for short periods in order to give the patient some respite. Ether in oil, administered rectally, likewise reduced convulsive seizures and was perhaps the best drug for the purpose under the prevailing conditions. Very little tribomoethanol (Avertin) was available, but, in the few patients who were fortunate enough to receive it, the relief was gratifying. The Filipino physicians were unanimous in advocating the use of a 25-percent solution of magnesium sulfate, injecting it intramuscularly in 2-cc. doses, and employed it almost routinely. It depresses respiration to an alarming degree. Sedatives of all kinds were of some value in controlling seizures and spasms, and, by conserving the patient's strength, life was frequently prolonged.

During February, March, and April of 1945, almost 500 patients were reported to have had tetanus in various civilian hospitals in Manila. It was estimated that there were, during this period, approximately 12,000 civilians wounded, and an incidence of almost 40 per thousand developed tetanus. The mortality rate for the 473 reported cases was 82.1 percent. These patients for the most part had little or no primary or early surgical care. As far as is known, none had had tetanus toxoid before being injured.

The incidence of tetanus in Manila under peacetime conditions would indicate that it would be high in combat. The American soldier was fighting under conditions quite similar as to climate and soil. His physical condition was, of course, superior to that of the average citizen of Manila. Furthermore, when wounded, he received early and adequate surgical care and, in addition, he had been immunized with tetanus toxoid. That this immunization was completely successful is borne out by the complete absence of tetanus among the U.S. Army forces on Luzon.

SPECIAL CONSIDERATIONS

Portable Surgical Hospitals

The portable surgical hospital consisting of 4 medical officers and 25 enlisted men became popular soon after it was introduced in 1942. It was a small compact mobile unit and could be attached to some elements of a combat team. In comparison to any other existing unit providing definitive surgical treatment of the wounded, it was easy to move and easy to supply. The deserved popularity of this unit and its accomplishments were, however, due to the personnel. The officers who volunteered for this type of service were exceptionally well trained. They in turn selected the best in the way of noncommissioned officers and enlisted men they could find. During the early days of the New Guinea campaign, the demand for this type of unit was great, and, had it not been available, many wounded would not have received the excellent care that they did. The portable surgical hospitals were used throughout the New Guinea campaign, through Leyte, and to a lesser degree in Luzon.

Sometimes, the same general conditions existed as prevailed in the early part of the New Guinea campaign, but, as the campaign progressed and greater numbers of troops were employed, the portable surgical hospital was still used. It had at best certain shortcomings. First, equipment—particularly for anesthesia—was limited; second, facilities for postoperative care were limited; and third, these units might result in a great waste of surgical personnel. Yet, if they did not contain excellent surgical talent, they were worse than useless—they were dangerous.

For small task forces fighting in the jungle, the portable surgical hospital, well staffed with a minimal amount of equipment, functioned to an unusual degree of efficiency. When this unit, however, was used where larger combat units were employed and where transportation was available, it was not the unit of choice in which to do definitive surgery. Because replacements in some of the earlier formed portable surgical hospitals were not of the same caliber as the personnel of the original groups and because in the formation of newer hospitals superior personnel was not placed in them, the quality of work under comparable circumstances became distinctly inferior. Small groups not well trained, out on their own, and confronted with problems far beyond them were apt to repeat unnecessary mistakes. The combination of portable surgical hospitals and clearing companies was permissible when other organizations were not available, but they did not constitute the proper unit for definitive war surgery. Portable surgical hospital units were too small for doing definitive surgery and they lacked personnel and equipment. Most importantly, they were unable to provide proper postoperative care and from a practical standpoint tended to evacuate postoperative patients too early. This was particularly applicable to patients operated upon for abdominal injuries. Far better were the 400-bed evacuation hospitals.

Surgical Teams

Surgical teams consisting of 2 officers and 4 enlisted men equipped with basic operating instruments were requested by the surgeon of the Sixth U.S. Army and provided by the Surgeon, SOS, SWPA. Orders provided for their assignment to the Sixth U.S. Army on temporary duty and their return to their original station when the duty was completed. In the army, these teams were assigned to those medical units where they could be employed most profitably. On Leyte 4 teams were used, and on Luzon 23 teams.

In th Sixth U.S. Army, it was the general policy to have one team attached to an evacuation hospital and two to each field hospital. Without exception these teams were well received by the forward units, and, from the time of their arrival, cooperation was excellent. The teams worked under the direction of the chief of the surgical service of the hospital to which they were attached. They were given the same responsibility as the regular staff members. One team functioned as a unit in the operating room when feasible. Teams

participated in the care of patients from shock ward to evacuation, caring for their own postoperative patients. When hospitals were carrying peakloads, the teams would often be split, and each surgeon was paired with a less experienced medical officer of the hospital staff to make up a team. Thus, very early, the teams were absorbed by the surgical service so that they functioned as an integral part of it. The great volume of work that the forward units were called upon to do taxed them all. The commanding officers and surgical chiefs of these hospitals stated that they could not have rendered the treatment that they were able to give the wounded had their staffs not been supplemented by these teams. For the most part, the hospitals that sent these teams deserved commendation for the careful selection of both the professional and technical personnel. The officers and men of the teams were well pleased with their experience, and their value was well demonstrated. Some of the teams were shifted from their original assignments when work became slack and help was needed elsewhere.

Two parachute surgical teams commanded by Capt. Robert S. McCleary, MC, under Lt. Col. Francis W. Regnier, MC, Surgeon, 11th Airborne Division, were first used near Ormoc on Leyte. Each team was composed of 2 medical officers and 12 enlisted men and was equipped with materials and instruments to enable them to do major surgery in the field. The first team to embark on a mission jumped in southern Leyte and in the ensuing 20 days cared for 160 patients, 42 being litter cases. There were 3 head, 4 chest, and 2 abdominal wounds; 18 compound fractures; and 1 appendectomy. Two patients died before operation could be undertaken. This experience demonstrated that this type of unit had a place with airborne troops who may for some time be isolated. The teams were used in other missions on Leyte and on southern Luzon.

Nurses in the Forward Area

In spite of the provision for nurses in field and evacuation hospitals, members of the Army Nurse Corps were not in the forward areas early when the patient loads were at their peak in these medical units. This was observed in the Admiralty Islands, in Netherlands New Guinea, Leyte, and Luzon. The immediate postoperative care of the wounded was without exception superior when nurses with years of training were in charge, in comparison to the Medical Department enlisted men—willing and enthusiastic as these enlisted men were. The care of the wounded would have been improved by placing nurses in all field and evacuation hospitals as soon as they were secure. Indeed, the small risk to which the nurses would have been subjected would have been greatly overshadowed by the service they could have performed. That this was not realized was attested to by the attitude of commanding officers, task force surgeons, and some members of the professional staff of various hospitals who held that "female" nurses were an added burden and required additional quarters and facilities, and that additional personnel for guards was

required. They frankly stated that they did not want them because they were too much trouble, and yet they had never had them forward in the early phases of an action. Some medical officers were naive enough to believe that the corpsmen were just as expert in postoperative care as the nurses. The standards for postoperative care were low among surgeons who professed to this belief. Another objection offered was that to bring nurses in after the men had put up the hospital and place them in charge in the care of the patients would be a blow to the corpsmen's morale.

There were many reasons, arguments, and opinions as to why nurses should have been in the forward areas much earlier than they were. No one could doubt that members of the Army Nurse Corps were capable of rendering nursing care far superior to that provided by the less well trained corpsmen. Furthermore, it would have been the rare experienced surgeon who did not consider that good nursing was of major importance in, and an inseparable part of, postoperative care. The contrast was evident when, in the later phases of the action, nurses arrived and assumed their role.

Clinical Research and Investigation

The need for an organization for the correlation and encouragement of clinical and laboratory research had prompted Col. Maurice C. Pincoffs, MC, Chief Consultant in Medicine, USAFFE, and Col. Henry M. Thomas, Senior Consultant in Medicine, SOS, SWPA, to request through the theater chief surgeon and the Office of the Surgeon General a medical general laboratory. From a surgeon's standpoint, it was highly desirable that hospital facilities and laboratory be combined. After considerable discussion among the consultants, it was decided to combine a 250-bed station hospital with the general medical laboratory to form a research unit. Because there were several medical officers in the theater who were interested in and capable of investigative work, as evidenced by previous accomplishments, it was requested that the general medical laboratory be sent to the theater with certain of its positions vacant. In March of 1944, requisitions having passed proper channels, word was received from the chief surgeon's office that a general medical laboratory with certain specified vacancies would arrive in the theater. Inability to secure proper priorities and other delays resulted, and the 19th Medical General Laboratory at Hollandia, New Guinea, did not disembark from the United States until August 1944, to arrive in September.

In the meantime, steps were taken to locate personnel within the theater who would contribute to such an organization. The 12th Station Hospital was selected to be combined with the medical general laboratory, and it was transferred from Australia to Hollandia. Plans were drawn up with the assistance of SOS, SWPA, engineers to house together the two organizations. Likewise, plans were made for such changes and additions required to render the Australian portable buildings suitable for scientific investigation in tropical New Guinea. The amount of material and extra equipment required was great.

However, with a high priority obtained in higher headquarters, the material was secured from quartermaster sources, then located in Sydney, Australia, and was placed aboard a liberty ship destined for Hollandia. Not long after the arrival of the 12th Station Hospital, the 19th Medical General Laboratory, and the extra equipment in Hollandia, the tactical program was stepped up for the invasion of the Philippine Islands and the project was curtailed, although the laboratory was later completed.

Clinical and laboratory investigation should have been considered an integral part and function of the Medical Department during service in a foreign theater. Knowledge of tropical surgery as well as tropical medicine could have been increased with profit much earlier, had the proper organization been available. Because there was no official organization of this type provided for, the construction and securing of one was met by a great deal of resistance. One ranking medical officer in the theater chief surgeon's office bitterly opposed "research in the jungle." A base surgeon of equal rank was insistent that such an organization would deprive the wounded of proper care. Such attitudes were relics of the dark ages, and they delayed progress.

A table of organization and equipment for a combined laboratory and hospital capable of doing clinical and laboratory investigation and including the facilities of a medical general laboratory should be set up for use in any future war.

CHAPTER XVIII

Seventh U.S. Army

Frank B. Berry, M.D.

THE LANDINGS IN SOUTHERN FRANCE

The invasion troops of the Seventh U.S. Army, which landed in southern France on 15 August 1944, consisted of the 3d, 36th, and 45th Infantry Divisions (fig. 88). All had had long combat service, either with the II Corps in the operations in North Africa, during the campaigns in 1942–43, or with the Fifth U.S. Army in Italy. These troops were therefore battlewise and were also thoroughly familiar with the functioning of their own first and second echelon medical services in combat, as well as with the functioning of supporting corps and army medical organizations.

With a single exception, the 51st Evacuation Hospital, all the hospital units originally assigned to the Seventh U.S. Army for the invasion had seen service in the North African, Sicilian, and Italian campaigns, and all were well staffed. When the 51st Evacuation Hospital landed in southern France, it had not even unpacked its equipment since loading at the port of embarkation in the United States. It was therefore an unknown quantity at the time of the landings. It had, however, a well-balanced and well-trained staff of surgeons who had been carefully selected for this particular mission, and it had functioned as a unit on extensive desert maneuvers in the Zone of Interior. As a result, it was soon able to carry heavy loads for sustained periods.

The teams of the 2d Auxiliary Surgical Group which landed on D-day in southern France had also seen service in all previous campaigns in the North African theater.

As a result of their previous experiences, these organizations were all familiar with the professional policies developed by Col. Edward D. Churchill, MC, Consultant in Surgery to the Surgeon, MTOUSA (Mediterranean (formerly North African) Theater of Operations, U.S. Army), and had profited by his instructions. They were also familiar with the professional aspects of medical care of military casualties as these policies were promulgated in the technical circular letters issued from the office of the theater surgeon. The surgical care of all patients in Seventh U.S. Army installations was originally based upon the principles developed in previous campaigns and set forth in these letters. Later, it was also based upon the principles set forth in publications from the Office of the Chief Surgeon, Headquarters, ETOUSA (European Theater of Operations, U.S. Army).

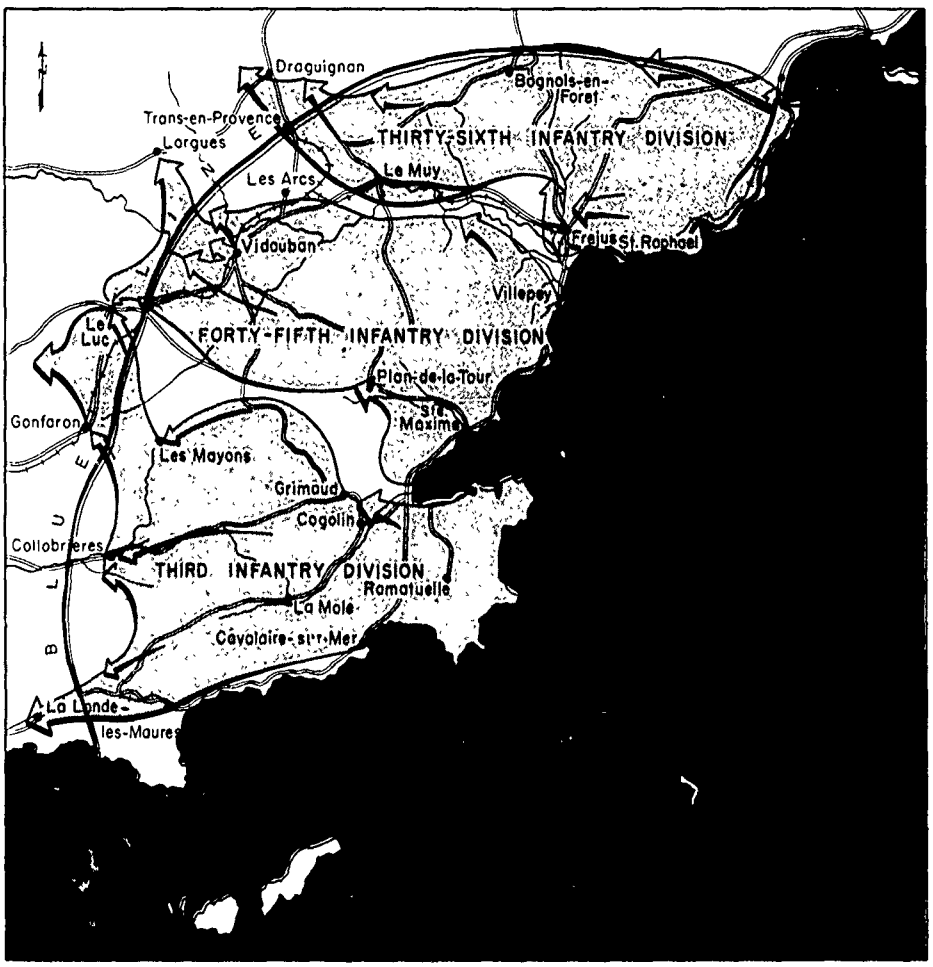


FIGURE 88. Landings of the 3d, 36th, and 45th Infantry Divisions, Seventh U.S. Army, and their maneuvers from beaches to Blue Line, 15 August 1944.

PRELIMINARY MEDICAL PLANNING

Plans for the provision of professional medical services for the invasion of southern France fell into the following four categories:

1. Definitive surgical policies were established in Circular Letter No. 2, Office of the Surgeon, Headquarters, Seventh U.S. Army, dated 18 July 1944 (appendix B, p. 583).

2. Additional personnel were provided for the field hospitals and 400-bed semimobile evacuation hospitals to be employed during the landing phase, as well as for the hospital ships, LST's (landing ships, tank), transports, and the First Special Service Force. The latter organization was a mixed Canadian

and American group, which, like rangers and commandos, had a special combat mission.

3. An adequate supply of fresh blood and adequate supplies of penicillin were provided to be landed with the assault forces on D-day. Provision was also made for the daily delivery thereafter, beginning on D+1, of blood and penicillin from Naples to France.

4. Assistance was offered to the First French Army, which was to accompany the Seventh U.S. Army, particularly in respect to supplemental training of medical officers, hospital supplies, and the delivery of blood.

Surgical Policies for the Invasion

Standard surgical policies for the care of the wounded in the Seventh U.S. Army were set up under the supervision of Col. Myron P. Rudolph, MC, army surgeon, and in consultation with Colonel Churchill.

The NATOUSA (North African Theater of Operations, U.S. Army) circular letters for 1943 and 1944, as well as Circular Letter No. 71, Office of the Chief Surgeon, ETOUSA,[1] were freely utilized in the preparation of aforementioned Circular Letter No. 2 which set forth the principles of professional management for the invasion and thereafter.

Plans were also made for a continuing flow of medical information to the consultant in surgery from army hospitals during the entire campaign, in order to assure the best standards of professional care by continuing analysis of the incidence of special types of wounds, the performance of special operations, the incidence of special complications, the use of whole blood, and similar matters. These data were requested in Circular No. 15 in August 1944[2] and are discussed later in this chapter under appropriate headings.

Hospitals and Medical Personnel

Planning for the invasion provided for the landing of hospitals and medical personnel by the following schedule. No nurses were put ashore with any unit until D+4.

1. Provision was made for the landing on D-day, with the first assault troops, of beach clearing companies, which were to be under Navy control until the landing forces had secured the beachhead. In the 3d and 45th Division sectors, the surgical teams attached to the field hospitals landed with the clearing companies and remained with them until the beachhead had been secured.

Two field hospitals were also to be landed with the next wave of assault troops. Two platoons of the 10th Field Hospital were to support the 3d Division, and two platoons of the 11th Field Hospital were to support the 36th

[1] Circular Letter No. 71, Office of the Chief Surgeon, ETOUSA, 15 May 1944, subject: Principles of Surgical Management in the Care of Battle Casualties.

[2] Circular No. 15, Seventh U.S. Army, 31 Aug. 1944.

Division. The third platoons of these hospitals were to land with the 45th Division.

Also to be landed with the invading troops was a detachment of the 2d Auxiliary Surgical Group, composed of 14 general surgical teams, 3 shock teams, 3 orthopedic teams, 2 thoracic-surgical teams, and 1 neurosurgical team. These teams were to be divided among the field hospitals.

The field hospitals which landed with the invading troops were also augmented by teams drawn from the 750-bed evacuation hospitals and the general hospitals designated for later landings. These teams, which were also intended to reinforce the 400-bed evacuation hospitals to be landed late on D-day and on D+1, included (1) general surgical teams, consisting of a surgeon, an assistant surgeon, an anesthesiologist, and two technicians, and (2) shock teams, consisting of one medical officer and three technicians. Skilled technicians were also drawn from the same pool and attached to field hospitals, to perform nursing functions until the nurses assigned to these hospitals were landed on D+4. All reinforcing personnel were to be automatically returned to their own units as soon as their units had been landed.

The forward distributing section of 6703d Blood Transfusion Unit (Overhead) also landed with the invading troops on D-day.

2. Plans were made for the landing on D-day and D+1 of three semimobile (400-bed) evacuation hospitals. Two maxillofacial teams, two dental-prosthetic teams, and one neurosurgical team, all from the 2d Auxiliary Surgical Group, were attached to these hospitals.

3. The nurses assigned to the field and 400-bed evacuation hospitals were to be landed on D+4, as were the nurses assigned to the teams of the 2d Auxiliary Surgical Group, which had been landed earlier.

4. Four 750-bed evacuation hospitals were to be landed between D+10 and D+15.

In addition to the personnel attached and assigned to the organizations just mentioned, other personnel had to be provided, as follows:

The First Special Service Force required six additional medical officers and one additional enlisted technician.

Forty medical officers were needed on transports and LST's, to care for the troops on them and for such wounded as might be evacuated by sea.

One or two additional surgeons were required for each of the hospital ships to arrive on the far shore on D+1 and D+2.

These special needs, as will be pointed out elsewhere, were underestimated in the initial planning.

MEDICAL ASPECTS OF THE INVASION

The landings in southern France were conducted as planned in almost all respects (fig. 89). The 3d Division landed on a beach to the west of Saint-

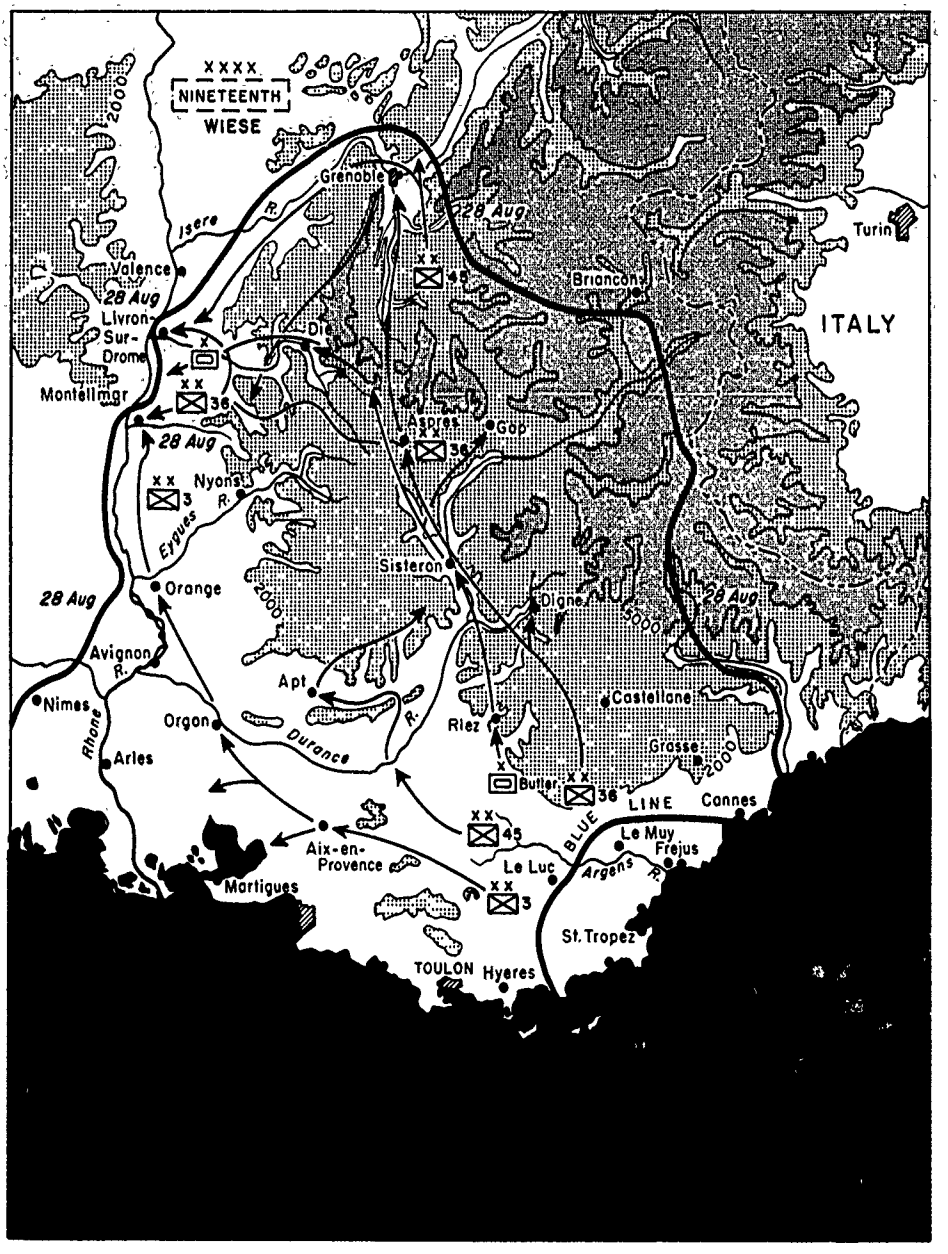


FIGURE 89.—Operations in southern France, 15–28 August 1944.

Tropez and the 45th Division landed on a beach to the east. The 36th Division, which landed at Saint-Raphaël, encountered considerable enemy resistance and was unable, until 48 hours after the first landings, to use one of the beaches which, according to plans, it was to occupy. The three areas on which troops were landed were about 50 miles from each other. Headquarters, Seventh U.S. Army, was located at Saint-Tropez.

Beach detachments (fig. 90) were set up almost immediately after the troops began to land, and, by the night of D-day, two field hospital platoons were in full operation. Shortly after the landings, the division surgeon of the 36th Division reattached two of the general surgical teams, which had landed with the 11th Field Hospital, to the beach clearing station of the 56th Medical Battalion, to permit more work to be done in it.

Each division had been made responsible for its own loading. The ETMD (Essential Technical Medical Data) reports for the 36th and 45th Divisions and for the 56th Medical Battalion reported too great dispersion in the loading of both personnel and equipment, with resulting delay and confusion in unloading and in the establishment of beach clearing stations and field hospitals.

The personnel and medical supplies of the 3d Division had been so loaded that both attached platoons of the 10th Field Hospital could be unloaded promptly on D-day. One platoon had been set up and was receiving patients late in the evening, and the other began to operate the following day. One of these platoons was located in the same area as the beach clearing station of the 52d Medical Battalion.

The personnel of some of the 400-bed evacuation hospitals landed on D-day. Their equipment began to be unloaded on D+1. The 93d Evacuation Hospital, supporting the 45th Division, began to operate on D+2, and the 11th and 95th Evacuation Hospitals on D+3. These three hospitals were reinforced by surgical teams and other teams from the 9th, 27th, and 59th Evacuation Hospitals (750-bed hospitals), which were to be landed between D+10 and D+15, as well as by teams from the 21st, 36th, and 43d General Hospitals. There was thus an abundant supply of medical officers and enlisted medical personnel on shore at all times. As later convoys arrived, some of the medical officers who had been withdrawn from general hospitals for temporary assignment to troopships were attached to evacuation hospitals then in operation while awaiting the arrival of their parent organizations.

Medical facilities to care for lightly wounded casualties who could be returned to duty, as well as for neuropsychiatric patients and patients with venereal disease, were set up and in operation by D+4.

The 6703d Blood Transfusion Unit (Overhead) landed as scheduled on D-day and was immediately attached to the 52d Medical Battalion. Later, it was attached to the platoon of the 10th Field Hospital supporting the 45th



FIGURE 90.—Views of naval and station on Red Beach just east of the town of Cavalaire sur Mer, France, in 3d Division Zone, shortly after landings on D-day, 15 August 1944.

Division. Still later, this unit was attached to the 93d Evacuation Hospital. There was an ample supply of blood at all times. The plane and boat service first employed, like the plane service which assumed the responsibility later, operated smoothly from the very beginning, and the courier on the plane was frequently used by other staff sections of the Seventh U.S. Army for the delivery of messages.

Distribution of penicillin for the landings was made the responsibility of blood bank personnel. The field hospitals also brought in a small initial supply with them, and 2,000 ampules accompanied the blood shipment which arrived on D+1. Additional amounts continued to be brought in by the planes transporting blood until all the penicillin required could be supplied and distributed through normal medical supply channels.

Two medical officers became casualties during the landings, when a half-track in which they were riding struck a mine. They were evacuated immediately by ship. The enlisted technician who had landed with the surgical consultant and who was trained in both anesthesia and operating-room technique took over the duties of the injured anesthesiologist (p. 515). The plastic surgical team to which the other injured officer was assigned was reconstituted as a general surgical team (p. 562).

CRITIQUE OF THE MEDICAL ASPECTS OF THE LANDINGS

Qualifications of an Army Surgical Consultant

The surgical consultant to a field army, who always works under the overall direction of the army surgeon, has the following important functions:

1. He establishes surgical policies for the army. While they are necessarily more detailed, these policies must be consistent with the policies established by the theater consultant in surgery, with whom the army consultant must be in frequent and close contact. The army consultant, however, provides specific as well as general direction and must meet given situations on his own authority as the needs arise.

2. He must be familiar with all the organizations assigned or attached to the army and must know their approximate troop strength and their tactical use. He must know which organizations are to make the initial landings and which are to be phased in at later dates. If an amphibious or oversea movement is planned, he must know the loading order.

3. He must know intimately all the details of medical support available for assignment and must be aware of the training and experience of the staff

of each medical unit, as well as of its composite experience, so that all assignments may be made in the light of this knowledge.

4. He is responsible, at all times, for the appraisal of the quality and adequacy of surgical equipment.

5. He is responsible also for assuring the adequacy of supplies of fresh blood and antibiotics for army medical treatment facilities.

6. He must know the medical facilities of the country in which the army is operating.

During the campaign itself, the duties of an army consultant in surgery, in addition to those just listed, include the following:

1. Provision of the best possible surgical care for battle casualties from the most forward medical units in division areas through convalescent hospitals in the rear army area, in order to insure the recovery, within the army area and within the shortest possible period, of the largest possible number of men who can be returned to combat. Provided that the tactical and other circumstances permit, it is highly desirable to hold within the army area those casualties whose physical condition will allow their return to duty within the established evacuation policy.

2. Cooperation and coordination with the operations section of the army surgeon's office, in order to insure that all hospitals are well placed and that their movements are timely.

3. Cooperation and coordination with the personnel section of the army surgeon's office, to insure that personnel for various installations are correctly selected and placed, so that they can do the best possible work in the light of their own abilities and the needs of the situation.

4. Collection of certain surgical statistics and the institution of special studies.

The outline of these duties of the consultant to a field army before, during, and after an invasion carries certain implications concerning his own qualifications and his place in the general military scheme.

It is almost essential that the consultant be a surgeon with academic standing in civilian life, who has held positions on the staff of a civilian hospital, who has had experience in the training and education of younger men, and who belongs to leading surgical societies.

These specifications obviously imply that the consultant will be a surgeon with the required training and experience, that he will know how to teach, and that he will have contacts with a wide circle of friends and acquaintances on a level of experience and training similar to his own. These are important considerations. An important phase of the consultant's duties will be the teaching of inexperienced surgeons, and another important phase will be the evaluation of personnel attached to units coming into the army area.

In short, the previous military experiences of the consultant in surgery to a field army, in addition to his surgical competence, in large measure determine his capacities for his work.[3]

Medicomilitary Experiences of the Surgical Consultant, Seventh U.S. Army

Headquarters, Seventh U.S. Army, was in Algiers at the time of the assignment of Lt. Col. (later Col.) Frank B. Berry, MC, (fig. 91), and the initial planning for the invasion, described elsewhere, took place there. Early in July, the headquarters was transferred to Naples, where the remaining plans for the invasion were made.

Colonel Berry sailed with the invasion troops from Naples on 14 August 1944. Twenty-four hours later, the target area was reached, and his ship lay off Saint-Tropez, waiting for the opening naval bombardment. H-hour was 0630 on 15 August. He went ashore later in the day, between 1600 and 1700 hours. The 36th Division, which had landed at Saint-Raphaël, about 25 miles overland from Saint-Tropez, where he went ashore, had run into trouble. The roads between the two towns were held by Germans, and it was D+2 before he got through to the medical units of this division. The area in which he was put ashore was heavily mined, and for the next several hours, while he thumbed rides from army vehicles for transportation from one medical facility to another, one of his important duties was to avoid mines.

His immediate duties as army consultant in surgery were clear. Certain urgent questions had to be settled immediately. How were the beach clearing

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[3] In World War I, Col. Frank B. Berry, MC, surgical consultant to the Seventh U.S. Army, had served as a medical officer in the Department of Supply (the World War I counterpart of the communications zone of World War II) in France.

In World War II, he left the Zone of Interior in September 1942, as chief of the surgical service, 9th Evacuation Hospital (the Roosevelt Hospital unit). After staging in England for about 5 weeks, this hospital landed in North Africa in November 1942, 8 days after the first landings. The hospital was assigned to the II Corps, which was the main fighting element of U.S. Army troops, from the landings until the end of the Tunisian campaign, and it served in direct support of the combat units of the corps from the end of January 1943 until the enemy surrender in Africa in May 1943.

The 9th Evacuation Hospital was assigned to the Seventh U.S. Army just before the invasion of Sicily. Early in September 1943, after the island had been taken, the hospital moved to Sicily, where it assumed the emergency and routine care of the troops staging to invade Italy.

Early in January 1944, when the French needed medical help, the 9th Evacuation Hospital was moved to Naples and was attached to the Peninsular Base Section. From this time, until July 1944, the hospital acted as a general hospital, caring for all French patients received from the First French Army, which was operating with the Fifth U.S. Army. This was a unique experience for an evacuation hospital, which does not ordinarily see the end results of its own surgery.

In May 1944, in response to a telegram from the War Department, Colonel Berry was declared available by the theater chief surgeon, Maj. Gen. Morrison C. Stayer, and was ordered to report to the Surgeon, Army Ground Forces, Washington, D.C. The assumption was that the Army Ground Forces was at last to have a much-needed consultant in surgery (p. 523). When he reached Algiers, Colonel Berry learned that Colonel Churchill had informed General Stayer that in the planning for the contemplated future operations of the Seventh U.S. Army, which had been designated for the invasion of southern Europe, he had been earmarked for assignment as consultant in surgery to that headquarters. General Stayer had not previously been informed of this contemplated assignment. Colonel Berry was given his choice—to report to Headquarters, Army Ground Forces, in Washington, or to be assigned to the Office of the Surgeon, Seventh U.S. Army, as consultant in surgery. He chose the latter assignment.—J. B. C., Jr.



FIGURE 91.—Col. Frank B. Berry, MC, Consultant in Surgery, Office of the Surgeon, Seventh U.S. Army.

stations operating? What was the status of the platoons of the field hospitals? Did they need extra help? Had the supplies of blood been landed? These and other matters occupied his time for the next several days.

Almost as soon as Colonel Berry had landed, he found work for the technical sergeant with training in anesthesia who had landed with him. They met a vehicle coming back from a field hospital and were told that the hospital anesthesiologist had been wounded by a mine. Colonel Berry instructed the technician accompanying him to go with the personnel on the vehicle to the field hospital, where he was put to work immediately.

All clearing stations on the beaches were operating smoothly. The platoons of the field hospitals attached to the 3d and the 45th Divisions were beginning to establish themselves a couple of miles back from the beach, and Colonel Berry spent the first night ashore with a platoon of the 10th Field Hospital which was attached to the 45th Division. Both platoons of this hospital were caring for patients by nightfall on D-day.

Until the field hospitals could receive patients, casualties from the beaches were being evacuated to hospital ships (fig. 92). Only surgery of the most

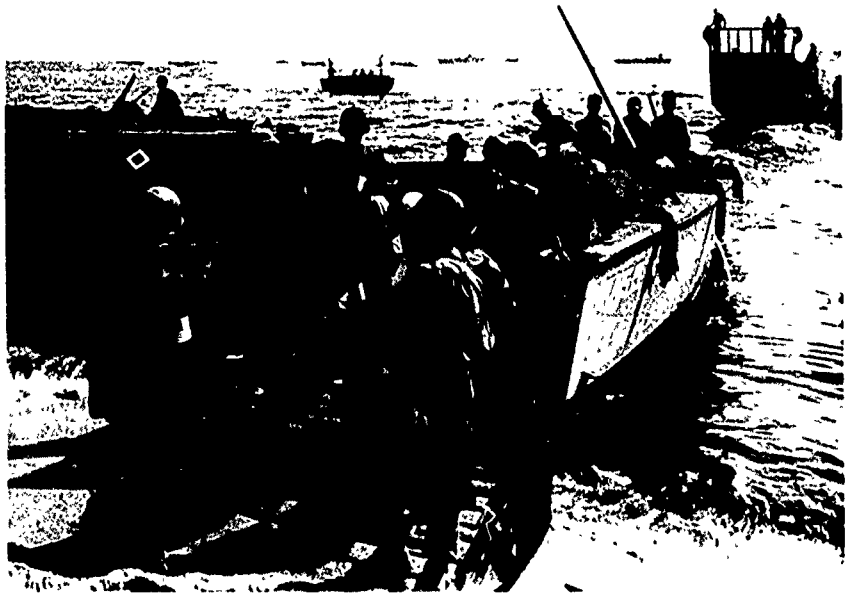


FIGURE 92.—Evacuation of wounded from beach to LCVP's (landing craft, vehicle and personnel) for transfer to hospital ships on D-day, 15 August 1944

urgent nature, such as the arrest of hemorrhage and operations for traumatic amputations, was being performed in the clearing stations.

Loadings of personnel and medical equipment of LST's and troopships had, on the whole, been efficient. No losses were suffered from sinking, but, if they had occurred, both personnel and equipment were so distributed that, if one ship or even more than one had gone down, the loss would not have been disastrous from a medical standpoint, as it had been in the Gulf of Salerno in 1943 when all of the equipment of the 8th Evacuation Hospital had been lost.

Each of the three divisions which landed in southern France had come ashore with supplies of blood (p. 526), and the blood was already in use when Colonel Berry landed. For the next 2 days, blood was brought ashore by boat. Checking with the liaison representatives of the Air Force, he found that the plans to bring blood in by plane were well understood, and on D + 3, blood began to arrive by air. There was never any real problem connected with either its supply or its delivery.

One of Colonel Berry's first duties after the landing was to see what help was needed by the medical service of the First French Army (p. 524). Such help as was necessary was rendered

Special Details of Planning and Execution

The whole invasion of southern France was an efficiently planned operation, from both the military and the medical standpoint, and, on the whole, it went according to plan. Hospitals were moved, without special difficulties, with the divisions which they were supporting. Field hospital platoons were often right up with the artillery, within a few miles of the front. On one occasion, near Crest, France, a platoon was caught in the line of fire, between German and U.S. Army artillery; they could hear shells going over in both directions but fortunately suffered no hits.

The following points deserve comment:

In order to fulfill his duties with the greatest possible efficiency, an army consultant in surgery must be included in all the planning of the army staff which involves medical support. This means that he must be cleared for the receipt and handling of top secret information. There must be frequent free contact, as well as mutual understanding and trust, between the consultant and the army surgeon, and plans and strategy must be discussed frankly between them. To provide him with the proper stature, the army consultant in surgery, like other key officers, should be known by the chief of staff and by the army commander also. On the other hand, the consultant must clearly realize the differentiation between his own functions and authority and the functions and authority of the army surgeon. He must acknowledge the authority of the army surgeon and make every effort to support him at all times and to improve his position with the entire army staff. When basic relations are on this plane, responsible duties can be carried out in an atmosphere of mutual trust and confidence.

Most of these requirements were fulfilled in the Seventh U.S. Army, but there were some deficiencies whose existence made for less competent planning than might otherwise have been possible. For one thing, the surgical consultant did not meet either the commanding general or the chief of staff until the troops were actually on the way to the invasion beaches. The initial contact, which was entirely accidental, opened the way to a cooperative future relationship.

More important, full knowledge of the initial phase of the oversea movement and the landings came to him piecemeal, much of it by indirection, and then only because he kept his eyes and ears open. The place of landing, the total number of medical units assigned to the Seventh U.S. Army, and the phasing of the landings of the others which were to come in later for support, also came to him piecemeal.

This was a basic fault. A consultant in surgery to a field army has heavy responsibilities, and, like other staff officers, he cannot fulfill them efficiently unless he has full information on all medical phases of an invasion or campaign. As it was, the surgical consultant to the Seventh U.S. Army had no broad, overall picture of the invasion beforehand, though in the planning of

any medicomilitary operation the total needs must be known in order to assure its success. This generalization applies to professional care and personnel as well as to needs of materiel. Under exigencies of war, of course, many last-minute changes may have to be effected, but, ideally, the consultant should have the picture in its entirety rather than piecemeal, so that the problem may be evaluated as a whole and action not be taken as a succession of afterthoughts.

If the total problem could have been visualized from the surgical standpoint well in advance of the landings in southern France, the total available medical personnel could have been utilized with much greater efficiency. The surgical consultant learned, for instance, only 5 or 6 days before the troops sailed, that a group of special Canadian and American ranger troops were to land on the Hyères Islands at H–6. The intrinsic medical leadership of this unit was good, but the medical staff required considerable strengthening. By the time the information concerning their needs had reached the surgical consultant, however, most of the additional personnel available from supporting units (p. 506) had been attached to the larger invasion commands. The mission of the rangers was important, but to supply additional personnel for them made it necessary to "scrape the bottom of the barrel." The results might have been expected. Three of the first group of supplemental medical officers attached to this force during their last days of training 125 miles south of Naples promptly developed the well-known military complaint of "severe lame backs." When, under appropriate authority, the consultant was seeking for replacements for them, the commanding officer of the general hospital from which he was seeking the replacements, himself a Regular Army officer, inquired whether he thought any of his men might get hurt. The consultant could have handled the rangers' medical problems better if he had known of their needs earlier.

Similarly, he had no advance information about any hospital or other ships designated to care for casualties which were to arrive in the target area during the first 3 days of the invasion. Had he known of these needs earlier, the ships would have been better supplied with surgical and shock teams and would also have had more liberal supplies of blood. As it was, the ships were somewhat understaffed, and blood was in somewhat short supply.

Functions of Medical Units

As noted elsewhere, the medical organizations designated to accompany the invasion troops which landed in southern France were well trained and, with a single exception, had had experience in previous combat. When the time for the invasion arrived, competent personnel were, as a rule, distributed to the best possible advantage in the light of the surgical consultant's somewhat incomplete knowledge of the invasion plans. With the arrival of new hospitals in the late fall, a number of additional changes were made. In some instances, poorly staffed evacuation hospitals were strengthened by

with surgical facilities and adequately staffed, to LST's, and to hospital ships. These ships should be equipped for major and minor surgery on large numbers of casualties. Their use keeps the beaches clear for other military and medical necessities.

The assignment of surgical and shock teams to beach medical battalions, field hospitals, and hospital ships further provides optimum initial care of the wounded during the first days of the invasion. It also assures a triple reserve against untoward eventualities.

The experiences during the invasion of southern France demonstrated that the personnel of evacuation hospitals should not be landed on D-day. Since their equipment cannot land with them, their presence on the beaches merely increases the problems of food supply, tentage for bivouac areas, and other logistic support, with no return for the effort. Evacuation hospitals are best landed between D+1 and D+4. The whole emphasis in the initial phases of a landing should be on (1) the beach clearing stations, (2) small, mobile units, such as field hospital platoons, and (3) augmentation of these units by surgical and shock teams.

In order to provide for the early return to duty of lightly wounded and ill personnel in the combat area, a medical unit equipped to handle convalescent-type patients must be set up within the first few days of a landing. Without provisions of this sort for lightly wounded casualties and for men with minor medical conditions and neuropsychiatric and venereal diseases, many soldiers who could return to duty within a few days will be evacuated out of the army area. It is obviously highly desirable to retain this type of patient in the army area; many of them, otherwise, will be lost to combat service.

Provision of Blood and Penicillin

The utilization of a blood plane and the distribution section of the 6703d Blood Transfusion Unit (Overhead) proved, as already stated, a highly efficient operation. The use of the same setup for the distribution of penicillin was adapted from a plan which had proved extremely successful in Italy. It proved equally successful in southern France. It not only provided a complete and elastic coverage for hospitals in the army area but also relieved the normal medical supply system, with its rapidly shifting depots, of what might otherwise have been a troublesome storage problem in the days immediately after the invasion.

Promulgation of Policy

In the initial planning phase of an invasion, it is important that as much basic information as possible concerning army policy be issued as command directives. That this plan was used in the circular issued about the optical repair units[4] was regarded as one of the reasons for their efficient operation

[4] Circular No. 16, Seventh U.S. Army, 4 Sept. 1944.

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(p. 532). A similar plan had been followed in the circular about trenchfoot[5] in Italy.

Consultants in the Surgical Subspecialties

In the actual landing operation, it is important that the consultant in surgery be accompanied by one or more specialists and one or more enlisted technicians. The ophthalmologist and the technician trained in anesthesia who made the landing with Colonel Berry on D-day were both employed by night (pp. 515, 531).

It does not seem necessary to have consultants in the surgical subspecialties in the office of the surgeon of a field army. It was the policy in the Seventh U.S. Army to use medical officers trained in orthopedic surgery, ophthalmology, and neurosurgery, but assigned to hospitals, as informal consultants, and the plan proved far more satisfactory than the overstaffing and the top-heavy structure which would have resulted from the formal appointment of a number of consultants in these specialties in the army surgeon's office. The success of this plan, of course, depends upon the availability of trained and competent personnel in the medical units of the specific army concerned. It also is contingent upon the authority given to the consultant in surgery to a field army to select and handle his own personnel. This he should have. The consultant to the theater chief surgeon should select for the consultant in surgery to the army a medical officer who is experienced and reliable and who is acceptable to the army surgeon. Then, he should permit the consultant to select the medical officers whom he wishes to assist him and should allow the consultant to use these officers in the manner which seems best to him.

Whether or not the consultant has a formal staff of consultants is immaterial. What matters is that he should have ready access to medical advice in problems arising in specialties outside of his immediate field.

Coordination Within the Office of the Army Surgeon

During the Seventh U.S. Army's campaign in the European theater, there was, perhaps, less close liaison between the consultant in surgery and the chiefs of the operations and the personnel branches of the army surgeon's office than might have been desirable. This lack manifested itself in two ways. The first was in occasional staffing difficulties, although all personnel questions were coordinated with the personnel section of the army surgeon's office. The consultant in surgery should know the personnel in the medical units in the army area, both those already assigned and those coming in, so that he can place the best qualified medical officers in the places in which they can be most useful

[5] Letter, Lt. Col. W. G. Caldwell, AGD, Adjutant General, to All Units, Seventh Army, 31 Dec. 1943, subject: Trench Foot.

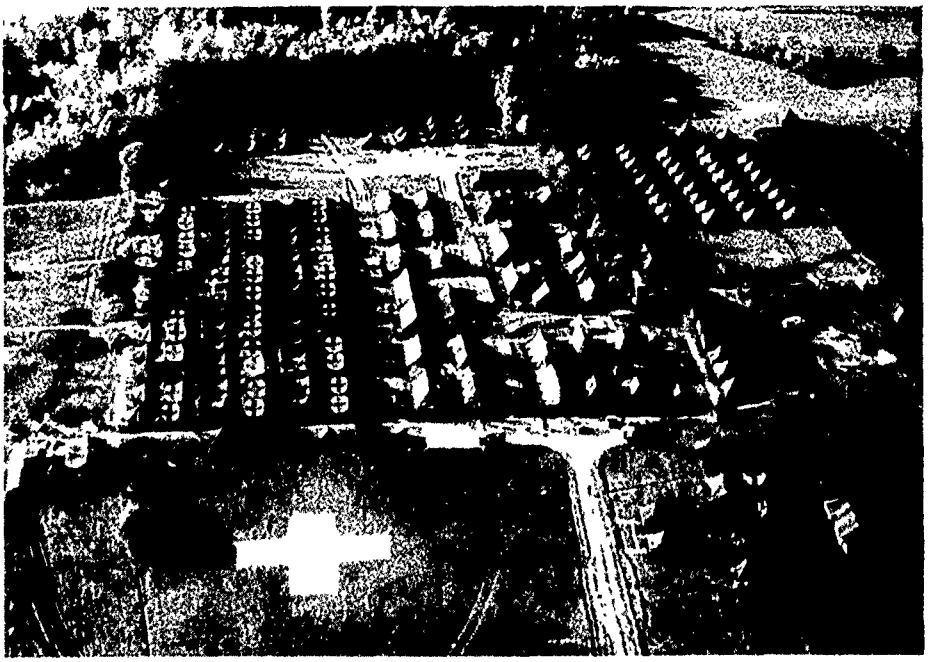


FIGURE 93.—The 27th Evacuation Hospital fully set up in France.

in the light of particular needs at particular times. This was usually, though not always, the situation in the Seventh U.S. Army hospitals.

The second evidence of occasional lack of liaison within the army surgeon's office concerned the operations branch. As a result of this lack, the selection of hospitals to be moved and the timing of the movements sometimes could have been improved upon. Tearing down and moving an evacuation hospital after it had been fully set up (fig. 93) presented a sizable problem. A consultant in surgery to a field army should be qualified, and should have sufficient information on both the medical and the tactical situation, to make recommendations concerning both hospitals to be moved at given times and the hospitals to be designated for special missions, since personnel as well as logistics must be taken into consideration. On at least one occasion, a serious situation developed in the Seventh U.S. Army because an inexperienced evacuation hospital, newly arrived and not effectively staffed, was assigned to a very active sector without the knowledge of the consultant, while, at the same time, an experienced hospital, excellently staffed, was left on the near side of the Rhine as a holding unit. The consultant would not have agreed to either assignment had he been consulted. The competent personnel of one hospital was wasted, while the other, as soon as the misassignment was discovered, required daily visits from him, as well as the augmentation of its weak staff by auxiliary surgical teams.

Assignment of Personnel

In retrospect, perhaps the matter of chief concern to a consultant in surgery in a field army, both during the invasion and later, has to do with personnel. The assignment of personnel during the invasion has already been discussed. Later, the major problems of personnel had to do with the staffing of evacuation hospitals coming into the army area from the Zone of Interior.

Evacuation hospitals carry a very responsible load, for the brunt of the initial surgery of the wounded falls upon them. Eyes, limbs, and lives will be sacrificed unnecessarily unless surgery of the highest quality is performed in them. In a field army, the consultant does not have sufficient leeway, or sufficient reserves of personnel, to correct staffing errors. An army in combat, in fact, never has a reserve of medical officers. On the contrary, it always has a deficit. Deficiencies in field hospitals can be covered by auxiliary surgical teams, but evacuation hospitals must, as a rule, take care of their own personnel problems. They must, therefore, be staffed with the greatest care in the Zone of Interior. This was not true of all hospitals which were assigned to the Seventh U.S. Army, and original errors in staffing were not always easy to correct overseas.

It is easy to explain why these mistakes were made. During the period of mobilization and training in the Zone of Interior in World War II, medical units other than those directly supporting the Army Air Forces were trained under the general supervision and control of two headquarters; namely, Headquarters, Army Ground Forces, and Headquarters, Army Service Forces. The training of evacuation hospitals was generally the responsibility of Army Ground Forces.

Early in the war, the Surgeon, Army Ground Forces, did not have detailed personnel records or other information to guide him in the assignment of professional officers of the Medical Corps. Such records as did exist were incomplete. They did not indicate the professional background of the individual officer or his stature in the civilian profession. Unless he was personally known to the Surgeon, Army Ground Forces, or to his immediate staff, he had to be assigned without the benefit of detailed knowledge concerning his professional and other capabilities.

Surgeons of the various armies in the Zone of Interior during the mobilization and training period of special units and before their departure for overseas were similarly handicapped in the assignment of medical officers for specific duties. An army surgeon, of course, had delegated to him by the army commander the authority to reassign medical officers within the army, the assignments being handled by normal staff procedures. An army surgeon, however, often had little or no more information about the various medical officers than did the Surgeon, Army Ground Forces, or, indeed, the Personnel Division, Office of the Surgeon General. Adequate, complete records were simply not available. The evaluation and classification of medical officers

according to specialties and their proficiency ratings within their specialties were a later development. This information, in fact, became available only after the planning for the European campaigns was over and could, in actuality, be put to use only after much of the fighting was over.

These facts explain why, during the period of training and mobilization in the Zone of Interior, medical officers were sometimes assigned to key spots in hospitals which they were not qualified to occupy, while other officers, junior in rank in the particular organizations, were sometimes better qualified to hold the more important posts.

The surgical consultant was fully cognizant of these difficulties and was quite aware that, under the circumstances, one of his principal duties was to visit newly arrived medical units and to develop, by all means at his disposal, full information concerning the professional as well as the military training and background of the various members of the hospital staff. The point to bear in mind is that, while theoretically the solution of the problem is simple—merely the movement of personnel from one post to another—practically this is never a simple matter because of demands for personnel in an army area overseas.

The problem in the Zone of Interior might have been at least partly resolved earlier, and with ultimate economy in medical personnel, if the surgeon of each army had had on his staff consultants in surgery, medicine, and neuropsychiatry. These consultants, however, were likely to be assigned just before the army departed for overseas. In the meantime, the personnel officer in the army surgeon's office, and, for that matter, the personnel officer in the Office of the Surgeon, Headquarters, Army Ground Forces, were most often medical administrative officers whose training and background in no way qualified them to evaluate the training and capabilities of professional medical officers.

Assistance to the First French Army

The First French Army had its own medical officers, but it was short-handed, and assistance was rendered to them when it was requested. By a semi-official arrangement, the Seventh U.S. Army consultant in surgery acted as an assistant consultant in surgery to them in cooperation with Col. Etienne Curtillet, who was organically assigned to this army as consultant in surgery. Colonel Curtillet was a member of the faculty of the University of Algiers, in which the level of surgical work was excellent.

During the staging period, the Seventh U.S. Army consultant frequently visited the French field and evacuation hospitals based in Naples, to maintain contact with them and to help them as much as possible with their organization and supply problems. Some of these hospitals were newly created. Others had served with the French forces in the Fifth U.S. Army during the winter and spring of 1943–44.

Colonel Curtillet landed in France, a few days after D-day. He and the Seventh U.S. Army consultant sometimes traveled together visiting U.S. Army

and French units as they were encountered. The Seventh U.S. Army did not furnish the French Army with medical officers but accepted two or three of their officers at a time for training in Seventh U.S. Army field hospitals. Thus, these hospitals would be jointly staffed by French and U.S. medical officers. The French appreciated the training, and they provided, in turn, much useful assistance. Some French casualties were also cared for in Seventh U.S. Army field hospitals.

Particular attention was paid to the French transfusion service, whose laboratories and main drawing unit were in Algiers. After many conferences with the Surgeon, First French Army, and with officers of the transfusion service, it was planned that blood would be flown daily from Algiers to Naples, in refrigerated boxes, and would be delivered to the French Army hospitals through the Seventh U.S. Army blood bank service. From Naples, the French supply of blood was delivered with the U.S. Army blood by courier on the beaches or to the advanced airfields, according to the stage of the campaign. The responsibility for maintaining liaison with the forward distributing section of the 6703d Blood Transfusion Unit (Overhead) as well as with the planes that transported the blood rested with the French. Minor difficulties were experienced in the implementation of this plan. The French liaison service frequently failed to maintain prompt contact with the airfields to which the blood was delivered, and some confusion in the supply of blood resulted, while at times there was a considerable accumulation of stocks of their full and empty blood containers at the airfields.

THE BLOOD PROGRAM

The story of the blood program in the Seventh U.S. Army falls into three phases as follows: (1) The provision for supplies of blood before the invasion, (2) the provision of blood during the landings and immediately thereafter, and (3) the routine provision of blood during the remainder of the campaign.

Preinvasion Planning

In February 1944, a central blood bank, designed to supply whole blood to the Fifth U.S. Army, was organized by Colonel Churchill with the full support of the Surgeon, NATOUSA, Brig. Gen. Frederick A. Blessé, who was succeeded on 1 March by Maj. Gen. Morrison C. Stayer. The project also had the full cooperation and support of Brig. Gen. (later Maj. Gen.) Joseph I. Martin, MC, Surgeon, Fifth U.S. Army. The blood bank, which was attached to the 15th Medical General Laboratory in Naples, under the command of Col. Virgil H. Cornell, MC, was officially designated as the 6713th Blood Transfusion Unit (Provisional) in April 1944.

The work of this transfusion unit was so satisfactory in supplying blood for the Fifth U.S. Army that a second, similar unit was activated for the purpose of drawing whole blood from base troops for the Seventh U.S. Army.

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Field and evacuation hospitals would thus be relieved of the almost impossible burden of drawing their own blood in the large quantities needed in forward installations, while the undesirable practice of bleeding line and service troops in forward areas would also be eliminated.

The second unit, designated the 6703d Blood Transfusion Unit (Overhead), was made up of personnel withdrawn between February and April 1944 from (1) an inactivated station hospital, (2) the 1st Mobile Medical Laboratory, and (3) the original blood transfusion unit set up in February 1944. The second unit, like the first, was attached to the 15th Medical General Laboratory for instruction and training. Eventually, two other bleeding stations for this unit were set up, one near Caserta, Italy, and the other, after the invasion, in Marseilles (p. 527).

The organization, training, and operation of both of these units were greatly facilitated by the hearty cooperation and interest of Colonel Arnest, Surgeon, Peninsular Base Section, and Colonel Cornell. As a result of their efforts, the 6703d Blood Transfusion Unit (Overhead) was a trained and smoothly functioning blood bank when it was assigned to the Seventh U.S. Army for invasion. All of its members deserve very great praise and credit for the superb backing which they gave to Army medical units throughout the campaign in southern France.

Before the invasion, the unit was divided into two functional sections. One was assigned to the 1st Mobile Medical Laboratory for the invasion. The personnel of the forward distributing section of the 6703d Unit which landed with the assault troops on D-day was attached to field hospitals for the landings. The base collecting section remained with the 15th Medical General Laboratory in Naples until adequate facilities could be set up in France (p. 527).

The Invasion

Personnel of the 6703d Blood Transfusion Unit (Overhead) were distributed as follows for the invasion:

An officer and an enlisted man were attached to a platoon of the 11th Field Hospital, which was attached to the 45th Division. They were supplied with seven box containers, containing a total of 188 bottles of blood. They also had with them the main refrigeration unit on a vehicle.

Two enlisted men were attached to a platoon of the 10th Field Hospital, which was attached to the 3d Division. They were supplied with four insulated box containers containing a total of 144 bottles of blood and with a refrigeration unit on a vehicle.

Two enlisted men were attached to a platoon of the 11th Field Hospital, which was attached to the 36th Division. They were supplied with seven box containers, containing 168 bottles of blood, and with a refrigeration unit on a vehicle.

The Special Service Force (p. 518) was given 100 bottles of blood in box containers, and additional amounts of blood were placed on some of the hospital ships supporting the invasion. More would have been supplied if the details of the use of these ships had been known earlier (p. 518).

All of the blood to be used on D-day was loaded just before departure, and a supply of whole blood not over 7 or 8 days old was thus assured for the immediate needs of the invasion. In planning for supplies of blood for the landings, the sound principles of combat loading were carefully observed; the blood was loaded late, so that it could be taken off the vessels early, and the supplies were distributed among several ships. To accomplish this required considerable persuasion of both corps and division surgeons and line officers.

Through the cooperation of the Navy and the Army Air Forces, arrangements were made to deliver whole blood to the target area, beginning on D+1 and continuing until an airstrip could be established. The plan involved flying blood from Naples to Corsica and then carrying it to the landing beaches by patrol vessels, motor torpedo boats. In all of this planning, the consultant in surgery received invaluable help from Colonel Cornell, who personally arranged for all contacts along the route of delivery of the blood, so that delays would be avoided. As a result, more blood than was necessary was always available during the landings, as well as later in the campaign. Contact with the collecting unit in Naples was maintained by daily cables and through the couriers who accompanied all shipments of blood.

Battle casualties for the first 3 days of the landings had been estimated at 1,881. Previous experience had indicated that about 0.6 pint of whole blood per battle casualty would be required. In addition to the small amounts provided for hospital ships, a total of 1,400 bottles of blood was provided for this period, which was an excess of 271 bottles over the calculated need of 1,129 bottles. The surplus was regarded as essential insurance against possible loss. Actually, battle casualties numbered 989, and nonbattle casualties, whose requirements for whole blood are generally less than those of battle casualties, numbered 205.

Postinvasion Experiences

The Seventh U.S. Army was fortunate in landing in territory occupied by friendly civilians. This made it possible, in October, to bring the collecting section of the blood transfusion unit from Naples into the rear of the army area and establish it at Marseilles, where it was located on the principal street, and where it was shortly handling about 200 donors a day, though it had been originally set up to draw only 100 bottles per day. A local supply of blood was thus available to supplement what came from Naples, and, later, when control of the Seventh U.S. Army passed from the Mediterranean theater to the European theater, to supplement what came from Paris.

When the collecting section of the blood transfusion unit was moved to France, this section and the 1st Medical Laboratory established a collecting

unit in the 59th Evacuation Hospital at Épinal. This unit, which operated for only 3 weeks, drew and processed during this time more than 2,400 bottles of blood. In order to use donors more efficiently during this period, group A as well as group O blood was supplied to hospitals. The 375 bottles processed were plainly labeled, and there were no untoward incidents.

Blood from the European theater reached Seventh U.S. Army hospitals for the first time in November 1944, when the logistic support of the army passed to that theater. The first shipment consisted of 350 bottles of blood drawn and processed in the European theater. Still later, blood was supplied to Seventh U.S. Army hospitals from the Zone of Interior through the European theater blood distribution organization; most of the blood used in these hospitals eventually came from that source.

The forward distributing section of the blood transfusion unit encountered increasing logistic difficulties in southern France from the time of the landings until March 1945. The distances were always long. The roads, through mountains, often were poor and frequently were snowbound and icebound. During December 1944 and January 1945, because of the Colmar Pocket, the front was divided into two rugged sectors. For this reason, in addition to the run of 130 miles to the rear, to pick up the blood from CONAD (Continental Advance Section, Communications Zone, ETOUSA) at Dijon, it was also necessary to make daily runs of 100 miles to each sector. Communications with the base were always difficult, often uncertain, tortuous at best, and, occasionally, impossible. After the air service had to be temporarily abandoned because of very bad flying conditions in October 1944, it often took 2 to 4 days for the two sections of the blood bank to communicate with each other, or to communicate with Paris through the Southern Line of Communications. It is remarkable that, in spite of these handicaps, there was never a lack of available blood. It is equally remarkable that this result was accomplished by a forward section that never consisted of more than one officer and five or six enlisted men and that operated entirely with its own three trucks and two borrowed weapons carriers.

On the other hand, poor liaison, bad roads, long hauls, and lack of adequate refrigeration resulted in a regrettable waste of blood both by hemolysis and by outdating. During January and February 1945, the loss by hemolysis alone (from shaking of the containers) amounted to about 30 percent of the blood supplied.

Early in March 1945, the supply of blood was greatly simplified when the services of two blood distributing sections were obtained from the 127th Station Hospital. These sections were attached to CONAD, and by CONAD to one of the air holding units, to act as a rear blood station. By this time, an effective means of daily communication had been set up with the blood bank in Paris. The rear blood station received all incoming blood from Paris, stored it, and shipped the containers back to Paris. This station was now able to care for the needs of most of the army hospitals and also the needs of the for-

ward distribution section of Blood Transfusion Company 6825, which was attached to the 132d Evacuation Hospital and which provided for the needs of the hospitals in the southern sector until the end of hostilities. After this company and the units from the 127th Station Hospital had returned to their parent organizations, late in May 1945, the hospitals in the Seventh U.S. Army became responsible for the operation of their own blood banks.

Table 14 shows the supply and distribution of blood and plasma in Seventh U.S. Army hospitals from D-day (15 August 1944) to 30 April 1945. A total

TABLE 14.—*Recorded receipts and distribution of blood and plasma in Seventh U.S. Army hospitals, 15 August 1944–30 April 1945* [1]

Disposition of blood and plasma	August 1944	September 1944–April 1945	Total
Units of blood:			
Landed on D-day	800	----------	800
Total received	2,080	84,640	86,720
Distributed to—			
Field hospitals	1,008	24,175	25,183
Evacuation hospitals	887	32,313	33,200
Total	1,895	56,488	58,383
Distributed to base	----------	8,558	8,558
Used in—			
Clearing stations	102	89	191
Field hospitals	662	17,415	18,077
Evacuation hospitals	638	25,277	25,915
Total	1,402	42,781	44,183
Known to have been discarded	----------	7,958	7,958
Patients transfused in—			
Field hospitals	----------	4,459	4,459
Evacuation hospitals	----------	13,461	13,461
Total	----------	17,920	17,920
Units of plasma used in—			
Field hospitals	358	14,081	14,439
Evacuation hospitals	1,392	23,390	24,782
Total	1,750	37,471	39,221

[1] In addition to the obvious discrepancies in this table, which are explained in the text and which are chiefly due to inaccurate records, the amount of blood distributed in October, because of a change in the method of records and the loss of certain records, is only estimated. It is believed that the records for the amount of blood used are reasonably accurate, and 500 units were added to this amount to estimate the total amount received during this month.

of 2,080 units were received during August, including 800 units landed on D-day, and a total of 84,640 units were received during the period September 1944 to April 1945. Of this amount, 8,558 bottles were distributed to the base, and, according to the records, 191 bottles were used in clearing stations, 18,077 bottles in field hospitals, and 25,915 in evacuation hospitals. The records show that 7,958 units were discarded. There is obviously a very wide discrepancy between the amount of blood received and the amount of blood used and otherwise accounted for. This can be explained in the following two ways: (1) The keeping of poor records, particularly the failure to record the amount of blood used for the large number of casualties who were resuscitated in field hospitals and then sent to evacuation hospitals for necessary surgery; and (2) the hoarding of blood which was later discarded without record, a practice which played a particularly large part in the wastage of blood during the winter months.

Transfusion Reactions

At the request of Lt. Col. (later Col.) Ralph M. Tovell, MC, Consultant in Anesthesia, Office of the Chief Surgeon, ETOUSA, an analysis was made of the reactions following 7,780 transfusions on which data were available in that office. The number of reactions recorded, 69 (0.9 percent), is regarded as much too low. The obvious explanation, again, lies in inadequate records; in field and evacuation hospitals, because of the heavy load of severely wounded casualties, only the serious reactions were recorded, and minor reactions were either missed or went unrecorded.

Blood secured in the European theater was preserved with acid citrate dextrose solution. Blood received from the United States was preserved with Alsever's solution which requires an excess of fluid and which is particularly undesirable when transfusion is necessary in head and chest cases. The age of the blood received from the United States and the early lack of refrigeration also accounted for some of the reactions which occurred. Another practical consideration was that the 1,000-cc. bottles which had to be used for blood preserved with Alsever's solution required almost twice the amount of space required for blood preserved with acid citrate dextrose solution.

Of the four deaths which occurred after blood transfusions, three followed the use of blood preserved with Alsever's solution. In two of the three cases, positive cultures were obtained from the blood which had been used; in one of these cases, the same micro-organisms were grown in a culture of the patient's blood. In the third case, no cultural studies were made, but the blood had a foul odor, and hemolysis was evident when it was examined later. All three of these patients went into profound shock after transfusion of 100 to 300 cc. of blood, and none of them responded to intensive resuscitative measures. All three, unfortunately, had had smooth and uncomplicated postoperative courses and were transfused merely to elevate the blood level before evacuation.

The fourth fatality occurred 3 days after the transfusion of 1,500 cc. of blood. Other causes perhaps played some part in the fatality, but the severe hemolytic reaction was unquestionably a contributory cause.

Medical officers from certain field and evacuation hospitals, especially the 9th and 51st Evacuation Hospitals, were particularly interested in transfusion reactions, the problem of anuria, and the use of type-specific blood in patients who required repeated transfusions. Their comments and suggestions were most helpful, and the records in these hospitals were particularly accurate.

SUPPLY AND TRANSPORTATION

Lt. Col. Augustus J. D. Guenther, MAC, Chief, Medical Supply Branch, Office of the Surgeon, Seventh U.S. Army, and the 7th Medical Depot Company deserve the highest praise for their efficient cooperation in the procurement of supplies for army hospitals. Many items in excess of basic allowances, such as suction apparatus, portable orthopedic tables, anesthesia apparatus, and laboratory equipment, were approved for issue by Colonel Rudolph, Surgeon, Seventh U.S. Army, and were supplied because their use would enhance the professional care of patients.

One service performed by the Medical Depot deserves special mention, the maintenance of surgical equipment, including sharpening and repair of instruments and repair of suction apparatus, sterilizers, and other essential equipment. Their repair had been a difficult problem in North Africa. Instruments and apparatus turned in for repair or salvage lay about on shelves or floors for weeks and sometimes were never returned. Sometimes, unacceptable substitutes were received in place of the original equipment. At that time, it was often simpler for hospitals to invoke the services of the Ordnance Corps for repairs than to try to have the work done by Medical Supply, whose rightful function it was. Problems of this kind did not arise in Seventh U.S. Army hospitals.

Transportation for semimobile (400-bed) evacuation hospitals was basically adequate. The 750-bed evacuation hospital was not intended to be semimobile but could have been made so if sufficient trucks had been provided. It is only fair to add, however, that all shortages of transportation were not attributable to shortages in the basic allotment but were due to the number of extras, captured accessories, and other excess items being moved by the hospital unit.

THE OPTICAL PROGRAM

Capt. (later Maj.) David B. Solouff, MC, ophthalmologist with the 9th Evacuation Hospital and a diplomate of the American Board of Ophthalmology, landed with the Seventh U.S. Army consultant in surgery on D-day and served throughout the campaign as an unofficial consultant in ophthalmology.

He visited all evacuation hospitals in the army area twice, discussing with the ophthalmologists on their staffs the problems of outpatient work, special surgical problems, and the efficient use of the optical repair unit. As new hospitals came into the army area, he evaluated the ophthalmologists on their staffs and advised concerning their training and capabilities. His work was of great value and was of great assistance to the surgical consultant.

The optical program for the repair or replacement of broken or lost spectacles is an excellent illustration of the detailed medical planning necessary for an invasion. From conversations with Brigadier Sir Stewart Duke-Elder, Consultant in Ophthalmology to the British Army, the surgical consultant had become fully aware of the importance of the prompt repair or replacement of spectacles. On one occasion, early in the campaign in North Africa, a replacement pool of 3,000 British troops had been held outside of Cairo solely because their broken or lost spectacles had not been repaired or replaced. For the same reasons, it was later necessary to evacuate a large number of men from the Anzio beachhead.

In the planning of the medical program for the invasion of southern France, arrangements were therefore made for the early landing of a mobile optical repair unit, which was in operation, with complete services on D+4. Many persons are completely incapacitated or seriously handicapped without their glasses, and it is natural that soldiers should desire to escape danger and avoid hazardous duties. For these practical reasons, the provision for the mobile optical unit so soon after the landings conserved a considerable amount of military manpower.

Circular No. 16, Seventh U.S. Army, dated 4 September 1944, directed that prescriptions for glasses and Government-issue glasses for repair should be sent to the 7th Medical Depot Company. The circular also provided that soldiers who were completely incapacitated without glasses (those with vision less than 20/200 O.U.) should remain in the hospital and that their glasses should be repaired on a first priority list. Later, one of the evacuation hospitals was designated as an alternate official collecting and distributing center for broken and lost spectacles, the glasses being sent to this hospital or to the medical supply depot, whichever was most convenient.

Colonel Guenther displayed a constant interest in the optical repair unit and made many helpful suggestions concerning it. The unit, which was under his operational control, deserves great credit for the promptness and efficiency of its work. From 15 August 1944 until the end of May 1945, 12,921 pieces of work were completed, and a daily average was maintained of 24 new pairs of spectacles and 6 repair jobs.

All evacuation hospitals were equipped with a trial lens case, in excess of tables of equipment. The load of refractions was at no time excessive, though some hospitals occasionally questioned the necessity for them.

EDUCATION AND TRAINING

It was routine practice in the Seventh U.S. Army, whenever a new unit designated for the care of combat casualties came into the army area, for it to undergo a period of training before it became operational. First of all, the consultant in surgery for the army visited it while it was staging and discussed major problems of personnel and procedure with the appropriate medical officers. Then, one of the following two plans was carried out:

1. The new unit was reinforced by experienced surgical teams, the senior member of one of the teams being designated as temporary chief of the surgical service of the hospital.

2. A key group of surgeons, nurses, and enlisted personnel from the new hospital was exchanged, for periods of 2 or 3 weeks, with a similar group from one of the older and more experienced hospitals. By this plan, a double type of teaching was provided, first by the older group attached to the new hospital, and second by the members of the more experienced hospital to which personnel from the new hospital were temporarily attached.

In addition to these formal plans of training, arrangements were made with nearby general hospitals for members of the staffs of newly arrived evacuation hospitals to visit them frequently, observe the wounded as they were received from the forward area, and witness the initial wound dressings and certain reparative procedures.

Experienced teams from auxiliary surgical groups were attached to new field hospitals, to instruct their staffs in procedures in the field. Lt. Col. James M. Sullivan, MC, 2d Auxiliary Surgical Group, who commanded the detachments of auxiliary surgical groups attached to the Seventh U.S. Army for the duration of the campaign in Europe, frequently visited the new hospitals, to instruct and assist their personnel.

The training supplies for medical officers of the First French Army has already been described (p. 524).

As far as was practical in an army area, all hospitals were encouraged to hold staff meetings. Three meetings of the Vosges Medical Society, Seventh U.S. Army, were arranged by the army surgeon. The subjects discussed at these meetings were, respectively, penetrating wounds of the knee joint, neuropsychiatric problems, and resuscitation and traumatic shock. The meetings were all well attended, and discussions were free and fruitful.

Medical officers in the Seventh U.S. Army were encouraged to produce reports for publication. The response was good. The 93d Evacuation Hospital submitted a report on intra-abdominal wounds. The 9th Evacuation Hospital prepared reports on neurosurgical problems and injuries of the knee joint and was preparing reports on intra-abdominal wounds when the medical meeting for which the papers were intended had to be canceled for reasons of combat. The 117th Evacuation Hospital presented an excellently worked up symposium on severe burns; the studies included detailed data on blood volume

hematocrit, hemoglobin, red and white blood cell counts, plasma proteins, and blood chlorides. Members of the 2d Auxiliary Surgical Group prepared papers on the differential diagnosis of abdominal injuries, the application of the principles of war surgery to thoracic injuries in civilian life, the early closure of soft-part defects by skin grafts, and wounds of the heart.

The surgical consultant to the Seventh U.S. Army presented a paper on wounds of the knee joint at a MTOUSA medical meeting in Naples in January 1945 and another on wounds of the chest at the 819th Hospital Center in Verdun in April 1945. At the request of the editor of the *ETOUSA Medical Journal*, he prepared a paper on surgery in the field for wounds of the abdomen. The consultant in surgery also attended three meetings of the U.S. and British Army consultants, two in Paris and one in Brussels.

MEDICAL UNITS

As has already been pointed out, all of the hospital units assigned to the Seventh U.S. Army for the invasion of southern France, with the single exception of the 51st Evacuation Hospital, had seen service in previous campaigns in the Mediterranean theater. The 51st Evacuation Hospital compensated for its lack of experience by an excellent and carefully selected staff. Five of the other six evacuation hospitals had participated in the North African, Sicilian, and Italian campaigns, and the 27th Evacuation Hospital had had some experience in Italy, while acting as a general hospital for the care of French troops. All of the field hospitals were experienced, and all were augmented by experienced teams from the 2d Auxiliary Surgical Group.

During the fall and winter of 1944–45, several new field and evacuation hospitals were assigned to the Seventh U.S. Army. The field hospitals included the 54th, and 66th, and the 81st Field Hospitals. The evacuation hospitals included the 112th, the 116th, and 117th, the 127th, and the 132d Evacuation Hospitals. The 57th and 64th Field Hospitals and the 103d Evacuation Hospital were also assigned to the Seventh U.S. Army for varying periods of time.

These hospitals varied in their experience and professional competence. The 54th Field Hospital and the 103d Evacuation Hospital had served with the Third U.S. Army. The 57th Field Hospital had functioned as a station hospital. The other hospitals were fresh from the Zone of Interior and had had little training as integrated units. Moreover, their professional staffs had been provided hurriedly just before the hospitals were sent overseas, and, as a result, inadequately trained and inexperienced medical officers were serving as chiefs of services and as senior surgeons.

The 81st Field Hospital and the 127th Evacuation Hospital, which arrived in the theater in March 1945, designated at first to care for prisoners of war and displaced persons, were assigned later to German concentration camps. They therefore did not require as numerous personnel changes or as close supervision as hospitals assigned to the care of combat casualties.

Measures were at once taken to train the new hospitals and instruct them in the general principles of military surgery. This was chiefly done by effecting exchanges of personnel between them and the more experienced evacuation hospitals. Even these changes did not bring the inexperienced units up to the level of more experienced organizations. This was especially true of the organizations that arrived in 1945. The theater could not supply the deficiencies in personnel, for just at this time, to complicate matters, the Chief Surgeon, ETOUSA, was calling on the hospitals in the army area for experienced surgeons to take charge of surgical services in newly arrived general hospitals in the Communications Zone.

Field Hospitals

The employment of field hospitals in southern France, both in the landings and later, followed the plan by which they had been employed with such great success in the Fifth U.S. Army. Difficulties of relationship were encountered in only one division, whose medical officers took, or seemed to take, the position that the field hospital was encroaching upon the rights and duties of the clearing station. This particular division sometimes left the field hospital to fend for itself, and it did not always choose sites for it which would place the hospital and the clearing station in the close proximity to each other required for each organization to perform the most efficient possible work. As a matter of fact, there is never any quarrel between these two types of organizations; their duties are clearly defined and sharply differentiated.

Although field hospital platoons were permitted to operate with as many as 50 beds each, it was found in the Seventh U.S. Army that the more nearly the census could be kept to 30 beds the better the hospitals functioned and the more mobile they were.

The work of field hospitals was limited to the care of nontransportable casualties. About half of these casualties could be sent back to evacuation hospitals after examination and resuscitation, though to maintain this proportion required careful evaluation and triage. The casualties who were retained and cared for in the field hospital were chiefly those with wounds of the abdomen and chest and major traumatic amputations (table 15). These casualties received prompt and expert care. Field hospitals in the Seventh U.S. Army were never employed as forward evacuation hospitals. Instead, they were used as a useful screen for the evacuation hospitals, increasing the ability of these hospitals to handle the main surgical load.

Evacuation Hospitals

The chief function of evacuation hospitals was the performance of initial wound surgery. All the evacuation hospitals in the Seventh U.S. Army rendered daily reports, as of midnight, concerning their surgical status; that is, the number of patients awaiting surgery and the number of hours estimated

TABLE 15.—*Summary of casualties, by body area, treated in field hospitals in Seventh U.S. Army, December 1944–April 1945* [1]

Body area	Admissions	Preoperative deaths		Operations	Postoperative deaths		Total deaths	
		Number	Percent		Number	Percent	Number	Percent
Abdomen	1,164	33	2.8	965	221	22.9	254	21.8
Thorax	1,459	37	2.5	562	79	14.1	116	8.0
Thoracoabdominal	306	8	2.6	272	82	30.1	90	29.4
Head	183	30	16.4	21	3	14.3	33	18.0
Spine	42	3	7.1	14	7	50.0	10	23.8
Upper extremity	200	-------	-------	90	1	1.1	1	.5
Lower extremity	699	13	1.9	347	37	10.7	50	7.2
Other	110	1	.9	11	-------	-------	1	.9

[1] The figures in this table present a fair sampling of the type of work done in field hospitals and of the results achieved. The lower case fatality rates in table 16 can be explained by the fact that the work presented in it was done in both field and evacuation hospitals, the work in evacuation hospitals having the diluting factor of having been done upon transportable casualties who were less seriously wounded than those operated on in field hospitals.

as necessary to clear up the backlog (surgical lag). A continuing effort was made to equalize the loads of the evacuation hospitals and to prevent the surgical lag from exceeding 8 hours, though this objective was naturally impossible of attainment in periods of sustained offensives, when casualties were heavy and hospitals moving rapidly.

Control of the surgical lag was, for all practical purposes, a matter of traffic regulation. A liaison officer, or a representative of the ambulance company who was either a commissioned or a noncommissioned officer, was stationed at each evacuation hospital, to control the flow of patients. When he saw the surgical lag becoming excessive, he took action to remedy it upon the advice and at the request of the chief of surgery. Several expedients would be employed. Priority II patients who could not return to their duties within the holding period of the army would be sent to general hospitals if they were transportable, particularly if, by the transfer, they would receive surgery earlier than in the evacuation hospital. A second possibility was a request to the Commanding Officer, Detachment 2d Auxiliary Surgical Group, to send whatever teams might be available to the evacuation hospital to help clear up the backlog.

Still another possibility was the diversion of casualties to hospitals in another army corps area. In times of stress, the representative of the ambulance company was not too closely confined by corps boundaries. Hospitals supporting different corps were often located close to each other, and it was only reasonable, if one hospital was overloaded, to divert patients to another whose work was lighter. Elasticity of services, resourcefulness of chiefs of surgery, evacuation officers, and liaison personnel, and coordination of administrative functions and professional services did much, in these circumstances, to decrease the surgical lag and insure earlier surgery for the wounded.

This whole concept was admirably stated in War Department Technical Bulletin (TB MED) 147, Notes on Care of Battle Casualties, dated March 1945:

a. The ever present necessity for evacuation of the wounded to the rear is in fundamental conflict with ideal surgical management of the individual patient. To minimize this conflict, *close coordination between the functions of administration and professional services is required.* It is the responsibility of the medical officer charged with the surgical management of the patient to place technical procedures properly, both in time and in space, with due regard to the tactical situation on the one hand and to the welfare of the patient on the other. Unless the surgeon visualizes his position and the function of his hospital in relation to other surgeons and other hospitals, he may become confused in the mission he is to perform. Although some needed operation may be performed correctly, the military effort may be impeded and unforeseen harm done to the patient if the operation is done at the wrong time or in the wrong place.

b. It is the *responsibility of administrative officers* charged with the establishment of evacuation and hospitalization policies to adapt the schedules of movement of patients to the maintenance of highest standards of surgical treatment. Priority of movement must be accorded to patients with certain types of injuries just as the duration of hospitalization in a given zone must be differentially adjusted to the urgent surgical needs of the patients.

Auxiliary Surgical Groups

The teams which participated in the landings in southern France in August 1944 were all from the 2d Auxiliary Surgical Group (p. 505). In November 1944, additional teams, all from the 1st Auxiliary Surgical Group, were assigned to the Seventh U.S. Army. This component consisted of eight surgical teams, two shock teams, two orthopedic teams, one thoracic-surgical team, one neurological team, one maxillofacial team, one dental-prosthetic team, and one X-ray team. These newly arrived teams were immediately attached, for operations and administration, to the detachment of the 2d Auxiliary Surgical Group already in the theater. Later, four surgical teams, two thoracic-surgical teams, one orthopedic team, one neurosurgical team, and one X-ray team, also from the 1st Auxiliary Surgical Group, were also assigned to the Seventh U.S. Army.

In order to facilitate their assimilation, new teams from the 1st Auxiliary Surgical Group worked, at first, with experienced teams of the 2d Auxiliary Surgical Group. Some of the new teams required considerable instruction. It was provided by this plan, as well as by the tireless efforts of Colonel Sullivan, Commanding Officer, 2d Auxiliary Surgical Group Detachment. The temporary union of components of two different auxiliary surgical groups proved a very wise plan. The groups served as a stimulus to each other. Some of the new teams had never before worked in field hospitals, and some teams which had had this experience were accustomed to being shifted about much more frequently than was the practice in Seventh U.S. Army hospitals.

Originally, some thought had been given to assigning an experienced surgeon from each team as commanding officer of each field hospital unit. The idea was abandoned, chiefly because it would have reduced the number of available teams, all of which were needed. Much the same end was

attained, and attained in a more effective fashion, by leaving the teams with the same field hospitals as long as possible rather than shifting them from hospital to hospital. In this way, a spirit of cooperation, and of semipermanence at least, was created.

An excellent source of instruction for both new and experienced teams was provided by the monthly autopsy reports. After the surgical consultant had studied these reports in his own office, they were forwarded to the teams which had handled the particular cases, with his own comments and with whatever additional details could be obtained.

In Seventh U.S. Army hospitals, all auxiliary surgical group teams were used as they were constituted, the nurses assigned to the various teams remaining with them permanently. In the First U.S. Army, nurse assistants assigned to the teams were apportioned among field hospitals and allowed to remain with them. The teams were then reconstituted, so that each consisted of four officers, including an anesthesiologist, and four enlisted technicians. The Surgeon, First U.S. Army, considered that the rearrangement increased the capacities for work of the whole group, which was essential with the heavy load of casualties cared for in hospitals in this army. The plan obviously has much to commend it, including the advantage of making life somewhat easier for the nurses.

Neurosurgical and maxillofacial teams were of maximum usefulness in evacuation hospitals and were usually attached to these installations. Other teams from auxiliary surgical groups, or their counterparts, served with field hospitals. If evacuation hospitals required assistance during rush periods or for other reasons, the necessary teams from these groups were temporarily attached to them. A surgical or thoracic-surgical team and an orthopedic team were usually attached to newly arrived evacuation hospitals for a week or two after they became operational.

Surgeons from the teams of the auxiliary surgical groups, as well as the teams themselves, were frequently given special assignments. Thus, one senior surgeon acted as chief of surgery in a Seventh U.S. Army evacuation hospital for 2 months. Another surgeon from a thoracic-surgical team spent 4 months on an exchange basis in an evacuation hospital, both to furnish instruction in thoracic surgery to the hospital staff and to permit two surgeons from the staff to see service in a field hospital. A maxillofacial and a thoracic-surgical team spent 3 months building up these special services in a busy general hospital. An X-ray team was permanently attached to an evacuation hospital that had lost its radiologist. Members of a surgical team were flown into Crailsheim, Germany, when the 10th Armored Division was temporarily surrounded. One team supported the 13th Artillery Brigade, First French Army. Another team was dispatched with a task force which had bottled up pockets of the enemy in Bordeaux and western France in April and May 1945.

In retrospect, it appears to this consultant that a number of changes might have improved the functioning of the teams of the auxiliary surgical

TABLE 16.—*Summary of casualties, by body area, treated by teams of 1st and 2d Auxiliary Surgical Groups in Seventh U.S. Army hospitals, 15 August 1944–9 May 1945*

Body area	Operations	Deaths	Case fatality rate
Abdomen	1,343	266	19.8
Thorax	655	43	6.6
Thoracoabdominal	520	92	17.7
Head	362	36	9.9
Maxillofacial	126	0	.0
Spine	14	2	14.3
Extremities:			
Upper	501	9	1.8
Lower	1,023	34	3.3
Other	465	15	3.2
Total	5,009	497	9.9

groups. Personnel of the teams might have been better balanced. There should have been, for example, a larger number of shock teams, at least two for every field hospital of three separate platoons committed to action, or at least two shock teams per division, based on a concept of one field hospital per division.

Orthopedic teams would have been more useful at the evacuation or general hospital level than in field hospitals. Definitive surgery on the extremities is not performed in field hospitals to any great extent, and orthopedic surgeons are not usually experienced in the type of surgery performed in them. Field hospitals need, above all else, surgical, thoracic-surgical, and shock teams.

X-ray teams did excellent work in augmenting the organic radiologic personnel in the hospitals, but it is questionable whether X-ray equipment is necessary for every team. Frequently, when the load of casualties is heavy, extra hands are needed, not extra equipment.

Statistics showing the work performed by the teams of the 1st and 2d Auxiliary Surgical Groups during their service with the Seventh U.S. Army are presented in table 16.

Convalescent-Type Facilities

The primary mission of the Army medical services in forward areas, as set forth in aforementioned TB MED 147, is twofold, as follows:

1. They must care for battle injuries and must care for, as well as prevent and minimize, nonbattle injuries and illness. All casualties must be given the best possible care, and, at the same time, hospital bed space must be conserved and the maximum number of casualties must be restored to duty.

2. In order to maintain mobility and keep hospital beds free for future casualties, prompt evacuation of the long-term sick and wounded from the combat areas is essential.

Convalescent-type hospitals, set up in the army area, lighten the strain on army hospitals and at the same time facilitate the return of sick and lightly wounded men to duty. Convalescent-type hospitals, as already mentioned, also care for neuropsychiatric patients and for patients with venereal disease.

In the Seventh U.S. Army, a clearing station was utilized for these purposes after the landings until authorized convalescent hospitals arrived. The experience in southern France proved that the prompt provision of a facility of this type was essential. The utilization of army medical collecting and clearing platoons (collecto-clearing platoons) solved the problem very satisfactorily. If these facilities had not been provided at once, lines of evacuation would have been further strained, and many men who were returned to duty within a few days would have been evacuated from the army area and would, perhaps, have been permanently lost to combat duty.

STATISTICAL DATA

Admissions, Deaths, Distribution of Wounds

During the course of the campaign in Europe, this consultant in surgery personally collected data on a total of 55,085 battle-incurred casualties treated in Seventh U.S. Army hospitals. These data were secured by providing, before the invasion, for their submission to the consultant at specified intervals (p. 507). They are not, of course, entirely accurate, and they differ, as personally collected statistics always differ, from official data. It is believed, however, that they are sufficiently reliable to permit certain conclusions to be drawn from them. They also show the volume of work handled in the various medical units of the Seventh U.S. Army. Most of them need little comment.

Table 17 shows the monthly distribution of admissions and deaths in the army hospitals and clearing stations for the whole period of the campaigns in France and Germany.

Tables 18, 19, and 20 show the distribution of admissions and deaths according to body area in Seventh Army field and evacuation hospitals. Table 21 shows the distribution of wounds according to body area based on division reports. Although the opportunities for careful examination of casualties in division medical facilities are less good than in other hospitals, the agreement between table 21 and table 18 is surprisingly close.

Table 22 shows the percentage distribution of wounds according to body area in the Mediterranean and European theaters in World War II in comparison with the distribution in other wars in United States history. The only notable discrepancy, that in the percentage of chest wounds in World War I, can probably be explained by the omission from this group of cases of injuries of the shoulder girdle.

TABLE 17.—*Monthly distribution of hospital and clearing station admissions and deaths, Seventh U.S. Army, 15 August 1944–7 May 1945*

Month	Admissions			Deaths		
	Casualties	Noncombat injuries	Disease	Hospital	Clearing station	Total
1944						
August	3, 126	1, 179	4, 948	----------	----------	68
September	3, 948	1, 398	7, 221	93	9	102
October	7, 203	1, 861	10, 208	189	24	213
November	7, 217	2, 779	11, 564	192	14	206
December	7, 847	3, 857	11, 939	179	31	210
1945						
January	9, 566	5, 444	13, 890	176	35	211
February	5, 100	3, 283	13, 583	126	24	150
March	8, 046	3, 383	14, 375	208	30	238
April	8, 834	3, 796	12, 656	201	79	370
Total	60, 887	26, 980	100, 384	1, 454	246	[1] 1, 768

[1] Note that this total exceeds the sum of the deaths for hospitals and clearing stations because there is no breakdown for August 1944.

Source: Reports of Casualties (WD MD Form No. 86f) and Combat Statistical Reports (ETOUSA MD Form No. 323).

TABLE 18.—*Distribution by type of hospital and body area of 55,085 battle-incurred wounds in Seventh U.S. Army hospitals*

Body area	Battle-incurred wounds					
	Field hospitals		Evacuation hospitals		Total	
	Number	*Percent*	*Number*	*Percent*	*Number*	*Percent*
Abdomen	1, 299	26. 0	906	1. 8	2, 205	4. 0
Thorax	1, 675	33. 6	2, 645	5. 3	4, 320	7. 8
Thoracoabdominal	264	5. 3	187	. 4	451	. 8
Head	188	3. 8	3, 163	6. 3	3, 351	6. 1
Maxillofacial	111	2. 2	3, 211	6. 4	3, 322	6. 0
Spine	49	1. 0	371	. 7	420	. 8
Upper extremity	285	5. 7	14, 174	28. 3	14, 459	26. 3
Lower extremity	860	17. 2	21, 044	42. 0	21, 904	39. 8
Other	260	5. 2	4, 393	8. 8	4, 653	8. 4
Total	4, 991	100. 0	50, 094	100. 0	55, 085	100. 0

TABLE 19.—*Case fatality rates according to type of hospital and body area in 55,085 battle-incurred wounds in Seventh U.S. Army hospitals*

Body area	Case fatality rate		
	Field hospitals	Evacuation hospitals	Total
Abdomen	24.6	11.5	19.2
Thorax	8.7	3.3	5.4
Thoracoabdominal	26.5	15.0	21.7
Head	18.6	8.8	9.1
Maxillofacial	2.7	.7	.8
Spine	20.4	8.1	9.5
Extremities	5.0	.3	.5
Other	8.5	.7	1.1

TABLE 20.—*Distribution, according to type of hospital and body area, of 1,360 deaths in 55,085 combat-incurred wounds in Seventh U.S. Army hospitals*

Body area	Deaths					
	Field hospitals		Evacuation hospitals		Total	
	Number	*Percent*	*Number*	*Percent*	*Number*	*Percent*
Abdomen	319	48.3	104	14.9	423	31.1
Thorax	146	22.1	88	12.6	234	17.2
Thoracoabdominal	70	10.6	28	4.0	98	7.2
Head	34	5.1	272	38.9	306	22.5
Maxillofacial	3	.5	24	3.4	27	2.0
Spine	10	1.5	30	4.3	40	2.9
Extremities	57	8.6	122	17.5	179	13.2
Other	22	3.3	31	4.4	53	3.9
Total	661	100.0	699	100.0	1,360	100.0

The most striking point in these tables is the extraordinarily low case fatality rate, 2.5 percent, in a war characterized by the use of enormously destructive weapons. The good results can be attributed to a combination of factors, beginning with the alertness, intelligence, and resourcefulness of the enlisted aidmen of the Medical Department on the battlefield and ending with expert and devoted nursing care on the part of the Army Nurse Corps, supplemented by the work of wardmasters and other nonprofessional ward personnel. From the surgical standpoint, a variety of factors must be taken into account, including an excellent regimen of resuscitation and postoperative management, with special emphasis on whole blood transfusions; excellent anesthesia; and the administration of penicillin and the sulfonamides as adjunct measures. None of these considerations, however, equaled in importance the performance of good surgery by well-trained and experienced surgeons.

TABLE 21.—*Distribution, by body area, of 48,299 wounds in Seventh U.S. Army casualties, according to division reports* [1]

Body area	Wounds	
	Number	Percent
Abdomen	1,607	3.3
Thorax	3,281	6.8
Thoracoabdominal	373	.8
Head	3,350	6.9
Maxillofacial	3,045	6.3
Spine	293	.6
Upper extremity	12,765	26.4
Lower extremity	18,427	38.2
Other	5,158	10.7
Total	48,299	100.0

[1] This table should be compared with table 18. These data were reported by divisions in which opportunities for careful examination were less good than in hospitals, yet the agreement between the distribution of wounds in the two tables is surprisingly close.

TABLE 22.—*Percentage distributions of body area and of wounded- or injured-in-action cases, by anatomic location, U.S. Army, in the Civil War and World Wars I and II*

Anatomic location	Body area [1]	World War II			World War I [4]	Civil War [4]
		Total [2]	European theater [3]	Mediterranean theater [4]		
Head, face, or neck	12.0	14.7	13.6	14.0	11.4	10.7
Chest	16.0	10.4	10.7	10.2	3.6	11.7
Abdomen	11.0	5.6	5.3	4.7	3.4	6.7
Upper extremity	22.0	27.9	27.4	29.2	36.2	35.7
Lower extremity	39.0	41.4	43.0	41.9	45.4	35.2
Total	100.0	100.0	100.0	100.0	100.0	100.0

[1] Based on a study by Burns and Zuckerman of the surface area of the human male body. The percentages shown represent proportions of total body area.

[2] Based on consolidations of various Army and theater reports and special studies encompassing some 460,000 wounded or injured in action.

[3] Based on consolidations of data from the First, Third, Seventh, and Ninth U.S. Field Armies.

[4] Based on experience of the Fifth U.S. Army during 1944.

[5] Distributions based on number of wounds, not wounded men.

Source: Medical Statistics Division, Office of the Surgeon General, Department of the Army.

Ballistics

It is curious, in view of the interest always evinced in the causative agents of combat-incurred wounds in all wars, that the figures for all recorded wars should be so grossly unreliable on this point. In an endeavor to improve this situation, it was requested that pertinent data be submitted each month by division clearing stations, from which, it was believed, the most accurate information could be secured because casualties are first observed in them and are most likely then to give a correct account of their injuries.

Of the more than 50,000 casualties whose wounds were analyzed from this standpoint, about one-quarter had sustained their wounds from small arms fire, and about three-quarters from high explosives. Wounding agents in 50,204 battle-incurred wounds were recorded by Seventh U.S. Army division clearing stations, as follows:

Wounding agent	*Wounds*
Bullets:	
Unspecified	4,790
Rifle	5,882
Machinegun	1,774
Total	12,446
High explosives:	
Shell (artillery)	5,389
Mine	1,868
Blast concussion	1,711
Bomb	557
Boobytrap	81
Grenade	22
Unspecified	28,130
Total	37,758
Grand total	50,204

In Fifth U.S. Army hospitals, the relative proportions were 18 percent and 78 percent; no information was available on this point in the other armies. Forty-three wounds caused by bayonets and other cutting weapons are not included in Seventh U.S. Army data.

Of the 251 deaths which were reported among the 50,204 battle-incurred injuries analyzed, 72 (28.7 percent) were caused by small arms fire and 179 (71.3 percent) by high explosives. These percentages correspond rather closely with the percentages of wounds caused by each type of weapon. The case fatality rate for small arms fire injuries was 0.57 percent and for high explosive injuries 0.47 percent.

Changes in the distribution of causative agents as the war progressed reflected the changing type of combat. In December 1944, 21 percent of the casualties were caused by small arms fire and 79 percent by high explosives.

As the breakthrough in the late winter and spring of 1945 became more and more complete and as the German Army progressively disintegrated, sniping, resistance by localized groups, and guerrilla tactics took the place of organized warfare. As a result, there was an increase in the proportion of wounds caused by small arms fire. In April 1945, in contrast to the December 1944 figures, 40 percent of the casualties were caused by small arms fire and 60 percent by high explosives.

Returns to Duty

The proportion of patients returned to duty from forward installations is shown in tables 23, 24, and 25. The total number returned to duty was 40 percent, the proportions for disease, non-combat-incurred injuries, and combat-incurred injuries being, respectively, 56 percent, 36 percent, and 16 percent.

TABLE 23.—*Hospital and clearing station admissions and dispositions, Seventh U.S. Army, 15 August 1944–7 May 1945*

Cause for admission	Direct admissions	Returned to duty		Evacuated	
	Number	*Number*	*Percent*	*Number*	*Percent*
Disease	103, 797	58, 350	56	39, 401	38
Nonbattle injury	29, 969	10, 707	36	19, 303	64
Battle injuries or wounds	63, 245	10. 017	16	49, 040	78
Total	197, 011	79, 074	40	107, 744	55

Source: Reports of Casualties (WD MD Form No. 86f) and Combat Statistical Reports (ETOUSA MD Form No. 323).

TABLE 24.—*Returns to duty from clearing stations and hospitals, Seventh U.S. Army, 1 September 1944–30 April 1945*

Month	Clearing station	Hospital	Total
1944			
September	1, 281	5, 266	6, 547
October	1, 830	5, 954	7, 784
November	2, 801	5, 739	8, 540
December	4, 627	6, 164	10, 791
1945			
January	4, 354	6, 090	10, 444
February	5, 709	6, 369	12, 078
March	4, 539	5, 274	9, 813
April	3, 144	5, 330	8, 474
Total	28, 285	46, 186	74, 471

Source Reports of Casualties (WD MD Form No. 86f) and Combat Statistical Reports (ETOUSA MD Form No. 323).

TABLE 25.—*Returns to duty from 400- and 750-bed evacuation hospitals in Seventh U.S. Army for a selected 3-month period*

Hospital	Admissions	Returns to duty	
400-bed hospitals:	*Number*	*Number*	*Percent*
11th Evacuation	4, 343	691	15. 9
93d Evacuation	4, 750	831	17. 5
95th Evacuation	4, 728	754	15. 9
Total	13, 821	2, 276	16. 0
750-bed hospitals:			
9th Evacuation	4, 573	984	21. 5
51st Evacuation	5, 310	1, 053	19. 8
59th Evacuation	8, 918	2, 040	22. 9
Total	18, 801	4, 077	21. 7

A number of suggestions were made concerning the alteration of medical facilities within the army area, or the increase of the facilities then provided, so that the percentage of returns to duty could be increased, with, at the same time, the conservation of medical manpower. These suggestions included special medical evacuation hospitals; special neuropsychiatric hospitals; the assignment of small surgical hospitals to each division; the provision of evacuation hospitals of uniform size (400 to 600 beds); a greater use of 750-bed evacuation hospitals; reorganization of the intrinsic staffs of evacuation hospitals by a reduction in personnel, to be compensated for by a wider use of auxiliary surgical teams; the use of an army field type of general hospital; and the conversion of convalescent hospitals into smaller, more mobile units or companies.

There is no doubt that, under certain tactical conditions, an increased utilization of smaller and more mobile hospitals of the convalescent type would increase the percentage of returns to duty within the army area. If evacuation hospitals were of two sizes, one should be kept relatively small and the other, which would be larger, would fill the needs then filled by existing evacuation hospitals. In both types of evacuation hospitals, the intrinsic staff would be augmented, as necessary, by the full employment of teams from auxiliary surgical groups.

Compared with smaller hospitals, a 750-bed evacuation hospital has the following two major disadvantages: (1) It is more difficult to displace the larger hospital, particularly if a withdrawal must be made and (2) when a 750-bed hospital is moving, it clogs the roads to a much greater degree than a 400-bed hospital.

On the other hand, experiences in the Seventh U.S. Army in World War II indicated that, from the standpoint of returns to duty, the 750-bed hospital is somewhat more efficient (table 25). The 400-bed and 750-bed hospitals listed

in table 25 were all similarly located over the 3-month period surveyed, all were employed during the same active offensive, and all had the same missions. The greater efficiency of the 750-bed hospitals may be attributed to their greater holding capacity, their ability to expand more rapidly than smaller hospitals, and their more diversified medical and surgical staffs.

CLINICAL POLICIES

The information on which the clinical portion of this chapter is based was secured, in part, from the information requested in Circular No. 15, Seventh U.S. Army, dated 31 August 1944 (p. 507). The data requested included the following:

1. Deaths by name, rank, Army service number, and organization, with a brief analysis of each case and pertinent comments.
2. The same information for all enucleations or eviscerations of the eye.
3. A breakdown of all major amputations (thigh, leg, arm, and forearm). Details of the case were to be supplied whenever it was thought that amputation could have been prevented.
4. Information on all injuries to major vessels and their management, with special attention to amputations.
5. Information on all cases of anaerobic myositis (name, rank, Army service number, and organization, with details of the management of the case and the results).
6. The same information on all wounds of major joints in which suppuration had occurred.
7. Information on all major infections of special interest or significance.
8. Data on transfusions, including the number given, the number of patients transfused, the total amount of blood used, the details of reactions, and any other information that might be useful concerning the use of whole blood.

The data secured by this command circular were recognized as not inclusive and, in some instances, as not altogether accurate; but they were ample to show clinical trends and to permit conclusions concerning special methods of treatment and other matters.

Resuscitation

One error never made in Seventh U.S. Army hospitals was to conceive of resuscitation as being limited to the administration of plasma or blood transfusions. On the contrary, resuscitation was regarded as a routine which required, in addition to the use of plasma, blood, or both, according to the indications of the special case, the following measures, also according to the indications of the special case: Control of hemorrhage; splinting of the wound; application of dressings; administration of morphine, if required for the control of pain, on the field or in the battalion aid station; administration of oxygen; aspiration of blood and air from the chest; injection of the intercostal nerves with procaine hydrochloride (Novocain); emptying of the stomach, the blad-

der, or both; maintenance of a free, dry airway; and a multitude of other procedures designed to make the patient a suitable candidate for surgery. Resuscitation, in short, ranged from protection of the casualty from unnecessary exposure immediately after injury to the final performance of initial wound surgery; even inexperienced surgeons soon came to realize that the act of operation was frequently an integral and essential phase of the routine of resuscitation.

Emphasis was constantly placed upon adequate blood replacement and the proper timing of surgery in relation to the administration of blood and the response to it. Excess administration of blood, however, particularly in wounds of the head and chest, was discouraged as both unnecessary and, occasionally, dangerous. The collected statistics show that administration of blood was at the rate of 0.44 pint per patient when both combat-incurred and noncombat injuries were considered and at the rate of 0.72 pint when only battle injuries were considered. The minimum monthly average was 0.54 pint per battle casualty in August 1944 and the maximum, 0.91 pint per battle casualty in April 1945. The increase is an index of the increasing experience gained by surgeons in army hospitals and clearing stations as the war progressed. The average amount of blood used in field hospitals, 3.9 pints per persons transfused, was, for obvious reasons, higher than the amount used in evacuation hospitals, which was 1.8 pints per person transfused.

The shock teams of the auxiliary surgical groups rendered invaluable assistance in all field hospitals, and all evacuation hospitals maintained an aggressive attitude toward this condition. Shock wards were well organized and were always under the direct supervision of experienced medical officers. A shock ward was no assignment for a medical officer who did not appreciate all of the problems and risks of shock in casualties with combat-incurred wounds, however competent he might be in civilian practice.

Anesthesia

Well-trained anesthesiologists were attached to all army hospitals and served on all auxiliary surgical teams. Anesthesia in forward hospitals was therefore always competently administered. Capt. (later Maj.) Daniel Massey, MC, 9th Evacuation Hospital, a diplomate of the American Board of Anesthesiology, was utilized informally as a consultant, just as Captain Solouff was used as an informal consultant in ophthalmology.

All new hospitals arrived with two officer anesthesiologists on their staffs. While their organizations were staging, these officers were placed on temporary duty in experienced field and evacuation hospitals, so that, when their own units went into action, they had already had some experience with combat-incurred injuries and had come to appreciate the difference between surgery for them and elective surgery, or even emergency surgery, in civilian practice.

At the request of Colonel Tovell, statistics on anesthesia were collected for a 6-month period in Seventh U.S. Army hospitals (table 26). The difference

TABLE 26.—*Distribution of anesthesia by type, and by type of hospital, Seventh U.S. Army, 1 November 1944–30 April 1945*

Type of anesthesia	Evacuation hospitals		Field hospitals	
	Cases	Percent	Cases	Percent
Intravenous (Pentothal sodium)	22, 363	53. 1	71	2. 8
Inhalation [1]	9, 762	23. 2	2, 148	86. 2
Combined intravenous and inhalation	3, 849	9. 1	56	2. 2
Field blocks	4, 904	11. 6	45	1. 8
Regional (miscellaneous)	558	1. 3	117	4. 7
Spinal	383	. 9	11	. 5
Sympathetic block	319	. 8	44	1. 8
Total	42, 138	100. 0	2, 492	100. 0

[1] Endotracheal anesthesia was used 3,042 times in evacuation hospitals and 1,782 times in field hospitals, this being 31.2 percent and 83.0 percent, respectively, of the inhalation anesthetics given in those installations.

between the methods used in field hospitals and those used in evacuation hospitals reflects the differences in the surgical problems encountered in the two types of installations. The much smaller percentage of endotracheal anesthesias given in evacuation hospitals (31.2 percent, versus 83.0 percent in field hospitals) is a further reflection of this fact.

Early in the experience in North Africa, the advantages as well as the added safety of a combination of intravenous anesthesia (thiopental sodium) and nitrous oxide anesthesia were not recognized. Had the war lasted longer, there is no doubt, considering the trend already evident, that this combination would have been employed even more frequently in evacuation hospitals, chiefly at the expense of some of the other techniques.

The inhalation agents most often used were ether and nitrous oxide, with induction by ethyl chloride. Chloroform was rather frequently used for induction in the 9th Evacuation Hospital, always under the direct supervision of Captain Massey. There were no reactions and no deaths.

Anesthesiologists in various army hospitals provided well-planned instruction in anesthesia for both nurses and carefully selected enlisted personnel on their staffs. As a result, most hospitals had 8 or 10 additional anesthetists who had had some special training, and bottlenecks because of anesthesia therefore seldom existed. The 9th Evacuation Hospital began to train enlisted personnel as anesthetists early in the Tunisian campaign. Instruction was given over a 2-year period by practical demonstrations, personal supervision, study groups, group discussions, and, eventually, clinical practice. This plan had several advantages. It assured the surgical section of a permanent group of trained anesthetists. It did not deplete the nursing section, which was always shorthanded. It provided an excellent stimulus for the enlisted personnel of the hospital. It was one of the trained technicians of this unit who went ashore with the surgical consultant on D-day and who was immediately

attached to the 10th Field Hospital, to replace the anesthesiologist who had been wounded during the landings. He served in this hospital until D+12, thus solving a problem which otherwise might have seriously delayed the care of the wounded.

The 11 deaths in Seventh U.S. Army hospitals which apparently must be attributed, wholly or in part, to anesthetic agents or to the accidents and complications of anesthesia were distributed as follows:

Three deaths were due to Pentothal sodium (thiopental sodium) anesthesia alone. The collected statistics show that this is a ratio of 1 to 7,211 anesthetics when Pentothal sodium was the sole agent and 1 to 8,799 anesthetics when it was combined with other agents. These ratios compared very favorably with those of civilian hospitals.

One death was due to combined Pentothal and spinal anesthesia.

One death was due to procaine poisoning following sympathetic block. The assumption was that the injection was probably too deep; the anesthetic agent was found in the spinal fluid.

One death occurred after ether anesthesia. In this case, open ether was administered through a mask held over an endotracheal tube and too high a concentration was undoubtedly given directly into the trachea. Death occurred on the second postoperative day, and autopsy revealed an extremely diffuse purulent capillary bronchitis.

One death followed the preanesthetic administration of morphine and atropine. The patient, who had acute appendicitis, went into collapse after the subcutaneous administration of 0.010 gm. of morphine and 0.0045 gm. of atropine. He did not respond to intensive efforts at resuscitation and died within an hour, without anesthesia or surgery. Although these are standard doses of the drugs, which are used routinely in preoperative preparation, the death must be charged to the medication.

One death was due to unrecognized obstruction of a bronchus by the endotracheal tube.

Three deaths were due to aspiration of vomitus with bronchial occlusion.

Chemotherapy and Antibiotic Therapy

The NATOUSA policy of administering penicillin to all casualties except the most lightly wounded immediately upon their arrival in forward army hospitals was followed in the Seventh U.S. Army. Later, when this army came under ETOUSA operational control, the first dose of penicillin was administered in clearing stations.

The protection afforded by penicillin permitted broadening of the scope of all surgery and, particularly, it permitted thorough debridement of wounds, regardless of the timelag between wounding and initial wound surgery. Penicillin proved to have many advantages over the sulfonamides previously used routinely. It was more potent. It had none of the untoward complications of the sulfonamides, particularly the renal complications. It did not depress

the bone marrow. On the other hand, while its use greatly improved the results of the operations performed in Seventh U.S. Army hospitals, penicillin was never regarded as a substitute for good surgery.

Penicillin was used locally as well as systemically, but only in delayed debridements, wounds of the chest and abdomen, and wounds involving the cerebrospinal system. Its topical use was discouraged under all other circumstances.

As a general rule, the administration of the sulfonamides was left to the discretion of the individual surgeon until the publication of Circular Letter No. 7, Office of the Surgeon, Seventh U.S. Army, dated 13 April 1945, which discouraged their local use as an adjunct to initial wound surgery. By this time, the concept had developed that their use within wounds was not only not beneficial but might be harmful.

There was no proof, one way or the other, that the employment of sulfonamide powder on first aid dressings had any real effects. There is, however, an inherent urge in man to put something on a fresh wound beyond a simple, dry, sterile dressing. It was thought wiser, therefore, not to interfere with this first-echelon practice, on the ground that it was not harmful and might be beneficial and that, in any event, it was superior to the application of iodine or a mercurial.

General Surgical Policies

General policies of surgical care of casualties in Seventh U.S. Army hospitals were stated in Circular Letter No. 2, Office of the Surgeon, Seventh U.S. Army, dated 18 July 1944. They were reiterated in Circular Letter No. 17, Office of the Surgeon, Seventh U.S. Army, dated 30 December 1944. The latter letter stated again the fundamental principles of initial wound surgery and dealt with specific types of wounds, particularly wounds of the right colon (p. 556). Both these letters, like the letters issued later dealing with special types of wounds, simply contained formal instructions for policies which had already been in effect and which experience had shown to be useful or necessary modifications of, or additions to, the policies officially established before the invasion of southern France.

The chief difficulty in new units was failure of their surgeons to realize the extreme importance of performing debridement according to fundamental principles. They fully appreciated the necessity for it in theory, but in practice they failed to consummate the theory. They were inclined to excise skin and superficial tissue while failing to incise fascial planes widely and to debride deeper tissues adequately. The resulting wound was relatively small and bulging, packed with gauze under tension, often infected, and seldom ready for closure at the first dressing.

As medical units in the Seventh U.S. Army gained in experience, their techniques of debridement improved. They came to realize that correct debridement is not a rough hacking away of tissues in hit-or-miss fashion but is,

instead, a precise operative procedure which demands good light, adequate assistance, wide incision of fascial planes, exposure of all recesses of the wound, careful hemostasis, anatomic dissection of tissues, complete removal of all damaged tissues, and a consistently atraumatic technique throughout all steps of the procedure.

Inexperienced medical officers also made other errors. They administered excessive doses of morphine. They sent patients to the rear inadequately protected with blankets, particularly blankets underneath the body. They were inclined to change dressings more often than was necessary in collecting and clearing stations. They evacuated patients from hospitals with intact or inadequately divided casts, tight dressings, poorly immobilized parts, unaspirated chests, retracting colostomies, and insufficient blood replacement.

These errors, which were all fairly common, were partly attributable to inexperience in military surgery and partly to failure to comprehend the entire medicomilitary situation. They were soon rectified by visits to, and comments from, more experienced general hospitals and older field and evacuation hospitals. When these errors were called to the attention of corps and division surgeons, these officers were always most cooperative and took immediate steps to correct them. As new medical officers gained in experience, they themselves came to appreciate the value of sound initial surgery and to realize that it protects the patient from infection and other complications, makes early reparative surgery possible, and achieves the greatest possible conservation of manpower.

REGIONAL INJURIES

Wounds of the Extremities

Wounds of the extremities accounted for about two-thirds of all admissions for battle-incurred wounds to Seventh U.S. Army hospitals. Wounds in the lower extremities were considerably more frequent than in the upper. In evacuation hospitals, these wounds made up about 70 percent of the workload. In field hospitals, they accounted for only about 30 or 35 percent, the rest of the load being made up of thoracic, abdominal, and thoracoabdominal wounds.

First echelon care was generally good. Tourniquets were used with discretion and efficiency, and their use seldom gave rise to complications. Occasionally, particularly in newly arrived medical units, morphine was administered in excess. At times, patients were received inadequately protected from exposure and with fractures unsplinted. It was sometimes difficult to impress upon inexperienced personnel that a properly dressed litter required blankets under the patient as well as over him.

The initial surgery of compound fractures in army facilities consisted of adequate resuscitation, proper debridement, careful appraisal and repair or other management of major vascular injuries, and the application of transportation casts. Patients with vascular injuries had to be held until viability of the limb was assured or amputation was obviously necessary. The principle



FIGURE 94.—Preparations for administration of blood to wounded soldier in evacuation hospital near Dijon, France, September 1944. Note the diagram of the fracture on the cast. Note also that the cast has been split, in accordance with regulations.

of complete debridement is paramount in modern military surgery and is nowhere more important than in compound fractures and wounds of the joints.

Some difficulty was encountered in impressing upon surgeons in new units the importance of such matters as firm but nonconstricting dressings and the correct position and support of the injured limb, as well as the vital necessity of completely splitting all casts and all layers of circular bandages and dressings (fig. 94). Unless casts were split before evacuation, preferably while they were still wet, patients were likely to be received in general hospitals with painful, swollen limbs, with the risk of serious infection increased, and with convalescence greatly prolonged.

The definitive treatment of major fractures was not the responsibility of field army hospitals. This function pertained to hospitals in communications zones and the Zone of Interior. Patients with serious fractures were given, as far as possible, early priority in transportation to general hospitals (fig. 95), so that they would arrive within 5 or 6 days after wounding, within the optimum period for initial wound dressing, delayed closure or redebridement, and initiation of treatment of the fracture.

In the rush of work, surgeons sometimes forgot that the institution and maintenance of traction were important phases of the routine of resuscitation in patients with fractures of the femur or tibia and that the practices also



FIGURE 95.—The 2,000-bed 36th General Hospital at Dijon, France, one of COMAD general hospitals in close support of the Seventh U.S. Army during the winter, 1944–45.

expedited initial wound surgery. Lt. Col. Donald McNeil, MC, attributed the exceptionally efficient management of compound fractures of the femur at the 51st Evacuation Hospital to strict adherence to this policy. In this hospital, after a wire had been placed through the lower femur or upper tibia, the limb was suspended to an overhead frame, at right angles to the body. This technique reduced or prevented shock, and the position gave complete access to all parts of the thigh, greatly simplifying the operative procedure, which otherwise would have been laborious and tiring. After debridement, traction was maintained until a transportation cast was applied.

Hand injuries. Special instructions for the management of hand injuries were given in Circular Letter No. 7, Office of the Surgeon, Seventh U.S. Army, dated 13 April 1945. In this letter, it was also directed that the local use of sulfonamides be discontinued and that plain fine-mesh gauze be substituted for petrolatum impregnated gauze as an initial wound dressing.

Wounds of the Joints

Major contributions to the initial management of wounds of the joints had been made in Fifth U.S. Army hospitals in Italy by Lt. Col. Oscar P. Hampton, Jr., MC, Consultant in Orthopedic Surgery to the Chief Surgeon. These policies, which were based upon the work of Pool[1] in World War I, were first

[1] Pool, Eugene H. Wounds of Joints. *In* The Medical Department of the United States Army in the World War. Surgery. Washington: Government Printing Office, 1927. vol. XI, pt. 1, pp. 317–341.

employed in the 9th Evacuation Hospital in Italy, while it was serving French casualties. They included formal arthrotomy in all wounds of the joints; complete debridement, with the removal of all foreign bodies, free bone fragments, and damaged and devitalized cartilage; thorough lavage; closure of the joint capsule; instillation of penicillin; and immobilization of the limb in a plaster spica or Tobruk splint.

Patients with wounds of the knee joint treated by this technique were followed up in general hospitals, and, as far as could be ascertained on informal surveys, the only infections which were present occurred in joints which were already grossly infected at the time of initial wound surgery and those in which the instructions concerning formal arthrotomy and complete debridement had not been followed. In the 9th and 51st Evacuation Hospitals, which conducted a special study of arthrotomies of the knee joint, only 2 infections were observed in 227 cases. One patient had undergone initial wound surgery 10 days after wounding and the other, 14 days after. Gross infection was present at the time in both cases. None of the other wounds showed any signs of infection when the patients were evacuated to the rear.

Compound fractures of the hip joint were, fortunately, not frequent. In previous wars, the subsequent course of these casualties had often been tragic, with long-drawn-out sepsis and, eventually, destruction of the joint to such an extent that major problems of reconstructive surgery were posed. In March 1945, two of the more experienced surgeons in the Seventh U.S. Army were requested to apply to wounds of the hip joint the bold policy which had met with such great success in wounds of the knee joint in both British and U.S. Armies. Before this policy was instituted, it was discussed informally with Brigadier Sir W. Rowley Bristow, Consultant in Orthopedic Surgery, RAMC, at a chance meeting. The procedure is much more formidable in the hip joint, but the urgent necessities of these wounds warranted its trial.

Colonel McNeil, of the 51st Evacuation Hospital, whose remarks on the preoperative use of traction have already been mentioned, had good results with it. Lt. Col. James E. Thompson, MC, reported in detail the nine formal arthrotomies of the hip joint which he had performed in the 9th Evacuation Hospital. In several of these cases, damage to the deep layers of the gluteus medius muscles and destruction of the gluteus minimus had been so extensive that no concept of the true situation could have been gained through the usual type of incision. The destroyed muscle tissue and the dirt and bits of clothing embedded in the wound could not have been completely visualized or completely removed unless a formal arthrotomy had been performed.[7]

[7] Colonel Thompson and Colonel Berry reported the follow up on seven of these nine cases at the meeting of the American Surgical Association in 1948. (Thompson, J. E., and Berry, F. B.: Penetrating Wounds of Major Joints. Tr. Am. S.A. 65: 567–584, 1947.) The late results were a convincing demonstration of the value of a bold approach to wounds of the hip joint.

Wounds of the Abdomen

In Seventh U.S. Army hospitals, contrary to the usual experience, approximately 40 percent of casualties with abdominal injuries received their initial treatment in evacuation hospitals instead of field hospitals. This was necessary because of the tactical situation. During one period of the fighting, an evacuation hospital was only about a quarter of a mile from the field hospital, which made it possible to distribute casualties to both according to their workloads. During three other periods of fighting, the same situation prevailed in respect to several field and evacuation hospitals. As a result, when field hospitals were under pressure, evacuation hospitals received casualties which would ordinarily have been cared for in hospitals farther forward. Finally, when field hospitals were moving, it was frequently the practice to take casualties directly to evacuation hospitals, in which, even though the ambulance haul was slightly longer, they could be cared for more promptly.

Patients with abdominal injuries were treated according to the sound policies already established in the Mediterranean and European theaters. The objective was to perform operation as soon as possible. With this idea, resuscitation was expedited, and in most cases was accomplished within 3 hours or less, the assumption being that, if a response was not observed within this period, either hemorrhage was continuing or massive peritoneal contamination was responsible for the continued state of shock. In both circumstances, surgery was regarded as a part of resuscitation and was proceeded with promptly.

In order to avoid ileocolostomy, which had given somewhat inferior results in hospitals in Italy, the following technique was employed in wounds of the right colon:[8]

1. If the wound of the ascending colon was small and clean cut, it was either exteriorized or repaired in two layers; in either case, a large cecostomy was provided.

2. If the damage was irreparable, resection of the involved area of the bowel was carried out, either in a single stage or in two stages, depending upon the extent of the lesion, the degree of peritonitis present, and the condition of the patient.

The two-stage operation was regarded as safer than single-stage surgery and was performed, whenever it was feasible, by the following technique:

After ileotransverse colostomy had been performed, the distal stump of the resected ileum was exteriorized, as a mucous fistula, well out in the right lower quadrant. A loop of transverse colon or the hepatic flexure just proximal to the anastomosis was then delivered through a subcostal incision. This loop was divided, and the ends were left open. The wounded portion of the colon was exteriorized either through the lower incision, with the ileum, or through the upper incision, along with the colon, whichever was simpler.

[8] Circular Letter No. 17, Office of Surgeon, Seventh U.S. Army, 30 Dec. 1944.

Although this technique was employed in only a limited number of cases, surgeons in both army and general hospitals reported good results with it. It caused less excoriation of the abdominal wall than the standard operation, nursing care was simpler, and patients seemed to recover more promptly.

In the collected series of 55,085 admissions for battle-incurred wounds, the case fatality rate for abdominal injuries was 19.2 percent. The rate in field hospitals was 24.6 percent and in evacuation hospitals 11.5 percent.

Wounds of the Thorax

Almost all casualties with wounds of the thorax were sent first to field hospitals for examination, evaluation of their wounds, and such resuscitation as might be necessary. About 40 percent were held in field hospitals for treatment; the remainder were regarded as safely transportable to evacuation hospitals for definitive treatment.

Early in the Seventh U.S. Army experience, some surgeons believed that formal thoracotomy should be performed rather frequently at the time of initial debridement and that the official policy of conservatism would produce less satisfactory results. As the campaign progressed, it became clear that results were better and fatalities fewer when the official policy was strictly followed. When these patients were evacuated to general hospitals, they were usually well on their way toward regaining normal lung expansion and function. Reports by general hospitals and observations in visits to these hospitals indicated that these results were permanent and not ephemeral.

Indications for primary thoracotomy, either by extension of the wound or by a separate incision at a site of election, were based on the policies which had been promulgated and practiced in the Mediterranean theater. They were as follows:

1. Continuing intrapleural hemorrhage not controlled by hemostasis in the course of debridement of the chest wall.
2. Anatomic or clinical evidence of penetration of the diaphragm.
3. Suspected visceral damage, the suspicion being based on the fact that a missile had traversed the mediastinum or lodged in it.
4. The presence of large intrapleural foreign bodies or debris readily accessible by extension of the traumatic wound.
5. Wounds of large bronchi or of the intrathoracic portion of the trachea.

The following conditions were not regarded, in themselves, as indications for initial formal primary thoracotomy:

1. The presence of foreign bodies (metallic fragments or bits of rib) in the lungs or of small fragments in the pleural space.
2. Hemothorax. (The evacuation of blood from the pleural cavity by suction at the time of debridement of the chest wall was not regarded as thoracotomy.)
3. Laceration or contusion of the lung in the absence of definite evidence of continuing hemorrhage.

Emphasis in all wounds of the thorax was placed on such details of effective resuscitation as complete aspiration of blood and air from the pleural cavity, aspiration of the tracheobronchial tree, and the administration of whole blood and oxygen as required. Warnings were issued against the use of excessive amounts of blood and other intravenous fluids in patients with wounds of the chest.

In the 55,085 hospital admissions for battle-incurred wounds analyzed, the case fatality rate for thoracic injuries was 5.4 percent. The case fatality rate in field hospitals was 8.7 percent, and that in evacuation hospitals, 3.3 percent.

Thoracoabdominal Wounds

Thoracoabdominal wounds accounted for about 5 percent of all admissions for battle-incurred wounds in Seventh U.S. Army hospitals. As surgeons gained more and more experience with them, it became the general practice to approach them first through the chest. This policy favored prompt restoration to normal of deranged cardiorespiratory physiology, and it permitted abdominal exploration and the necessary intra-abdominal surgery under the most favorable possible circumstances.

In the 55,085 hospital admissions for battle-incurred wounds analyzed, the case fatality rate for thoracoabdominal injuries was 21.7 percent. The case fatality rate in field hospitals was 26.5 percent, and that in evacuation hospitals, 15.0 percent.

Wounds of the Head and Spine

The Seventh U.S. Army was particularly fortunate in its complement of nine experienced neurosurgeons, and neurosurgery, as a result, was extremely well covered. Five of these highly trained neurosurgeons were assigned to hospitals, and four to neurosurgical teams. One of these teams was attached to a field hospital for the landings, but it was soon realized that the services of a neurosurgeon could be better utilized in an evacuation hospital, and the appropriate transfer was made. Full use was also made of three other surgeons who had some previous experience in neurosurgery.

At the suggestion of Col. R. Glen Spurling, MC, Senior Consultant in Neurosurgery, ETOUSA, four of the neurosurgeons attached to Seventh U.S. Army hospitals and neurosurgical teams were given 60-day temporary duty transfers to neurosurgical centers in the United Kingdom Base, and four of the surgeons from those centers served in the Seventh U.S. Army hospitals for the same period. This plan proved highly beneficial, not only in the variety of experience which it permitted but also because of the opportunities it gave to each group to comprehend the problems of the other group.

At Colonel Spurling's request, data for injuries of the head (tables 27 and 28) and injuries of the spine (table 29) in Seventh U.S. Army evacuation hospitals were analyzed for a 5-month period.

TABLE 27.—*Management and results in 717 penetrating wounds of the head in eight Seventh U.S. Army evacuation hospitals for a selected 5-month period*

Evacuation hospital	Total			Nonsurgical deaths		Surgical cases		
	Cases	Deaths	Percent	Number	Percent	Number	Deaths	Percent
9th	113	17	15.0	11	9.7	102	6	5.9
11th	126	28	22.2	15	11.9	111	13	11.7
27th	87	14	16.1	6	6.9	81	8	9.9
51st	44	19	43.2	8	18.2	36	11	30.6
59th	89	34	38.2	22	24.7	67	12	17.9
93d	81	15	18.5	11	13.6	70	4	5.7
95th	96	22	22.9	12	13.5	84	10	11.9
116th	81	20	24.7	16	19.8	65	4	6.2
Total	717	169	23.6	101	14.1	616	68	11.0

TABLE 28.—*Results in 616 surgically managed wounds of the head in relation to dural penetration in eight Seventh U.S. Army evacuation hospitals for a selected 5-month period*

Evacuation hospital	Dural penetration			No dural penetration			Total		
	Cases	Deaths	Percent	Cases	Deaths	Percent	Cases	Deaths	Percent
9th	98	5	5.1	4	1	25.0	102	6	5.9
11th	81	12	14.8	30	1	3.3	111	13	11.7
27th	66	7	10.6	15	1	6.7	81	8	9.9
51st	31	11	35.5	5	0	.0	36	11	30.6
59th	52	12	23.1	15	0	.0	67	12	17.9
93d	54	3	5.5	16	1	6.3	70	4	5.7
95th	72	9	12.5	12	1	8.3	84	10	11.9
116th	51	4	7.8	14	0	.0	65	4	6.2
Total	505	63	12.5	111	5	4.5	616	68	11.0

Wounds of the Blood Vessels

Many of the amputations performed in Seventh U.S. Army hospitals were necessitated by wounds of the major arteries. Amputation was necessary in nearly 30 percent of 1,086 vascular injuries on which data were personally collected (table 30). On the basis of this analysis, Circular Letter No. 9, dated 18 May 1945,[9] was prepared, but its distribution was accomplished too late for it to be useful during hostilities. The policies which it stated, however, had already been in effect for a considerable time.

[9] Circular Letter No. 9, Office of the Surgeon, Seventh U.S. Army, 18 May 1945.

TABLE 29.—*Essential data in 182 spinal cord injuries in eight Seventh U.S. Army evacuation hospitals for a selected 5-month period*

Evacuation hospital	All cases	Location of injury			Paralysis		Laminectomy			Suprapubic cystostomy	Case fatality rate	
		Cervical	Dorsal	Lumbosacral	Complete	Incomplete	Number	Average timelag (hours)	Number improved		Nonsurgical	Surgical
9th	37	6	12	19	14	23	22	24	12	12	6.6	13.6
11th	37	6	24	7	21	16	23	13	10	12	50.0	8.7
27th	33	7	12	14	8	25	20	58	6	23	.0	5.0
51st	6	0	3	3	3	3	6	8	2	1	.0	.0
59th	20	5	12	3	15	5	11	14	1	12	33.0	27.3
93d	19	4	13	2	12	7	9	----	2	8	60.0	33.0
95th	24	5	12	7	19	5	21	26	4	0	66.6	24.0
116th	6	1	4	1	5	1	1	12	0	1	.0	.0
Total	182	34	92	56	97	85	113		37	69		

The first principle of management of vascular injuries was that it should be conservative, with amputation the last resort. Repair of the damaged artery was to be effected whenever possible. Sympathetic lumbar blocks were done routinely with procaine, and lumbar sympathectomy was performed in a few instances.

Suture was always employed when the technique was feasible. Evaluation of the techniques in which prostheses were employed is difficult because no single procedure was carried out in a large series of cases. Survival of the limb followed the use of vein transplants in two of four cases. One limb survived after the use of a polyethylene tube transplant and another after the use of a glass tube. It is impossible even to comment on such small numbers of cases, though, of the artificial grafts and prostheses employed, polyethylene tubing was thought preferable to Blakemore metallic cuffs and vein grafts because the technique was simpler.

In March and April 1945, heparin became available in limited quantities and seemed to be of some value, though it is known that in at least one instance serious delayed oozing followed its use. It was thought that a more extended trial might have demonstrated it to be of real usefulness if it were used with the proper precautions.

Actually, the outcome of every arterial wound depended in large measure upon the nature of the injury: Whether the wound was small and clean, or large, contaminated, and infected, with widespread destruction of tissue; whether the vessel was completely or only partly divided; whether the injury

TABLE 31.—*Anatomic location and origin of casualties in 1,211 amputations in Seventh U.S. Army hospitals*

Location of amputation	Origin of casualty		
	U.S. Army personnel	Non-U.S. Army personnel	Not differentiated
Arm	101	33	41
Forearm	98	20	13
Thigh	316	83	49
Leg	689	105	82
Not stated	7	11	92
Total	1, 211	252	277

Maxillofacial Wounds

Three Seventh U.S. Army hospitals, the 9th, the 27th, and the 117th Evacuation Hospitals, had strong maxillofacial sections, and the policy, as far as it was practical, was to send most maxillofacial injuries to them. The other hospitals showed varying degrees of interest in this special problem.

One of the two maxillofacial surgery teams which landed on D-day lost its senior surgeon, by wounding, almost immediately (p. 512). It was reconstituted as a general surgical team, the need for which was then greater; this team thus had the added advantage of having, as one of its members, a surgeon with some experience in maxillofacial surgery. For the same reason—that the need for general surgical teams was greater—a third maxillofacial surgery team which arrived in southern France, in December 1944 was reconstituted as a surgical team.

As the experience in the Seventh U.S. Army area showed, serious maxillofacial injuries are best handled in evacuation hospitals, in which trained oral and maxillofacial surgeons are available to treat them. Maxillofacial teams are also more usefully employed at this level rather than in field hospitals. If hemorrhage is arrested and a proper airway is established and maintained, casualties with this type of injury tolerate transportation very well, prone or sitting forward, though they may require the attention of special attendants while they are in transit. If, for any reason, a casualty with a maxillofacial injury had to be held in a field hospital, a maxillofacial team could go forward to treat him, exactly as was the practice when other specialized injuries required treatment in a more forward hospital.

Wounds of the Eye

Only the simplest and most urgent ophthalmologic surgery was performed in army facilities. Every effort was made to conserve the eyes. There is no doubt that some wounds required additional surgery in the com-

TABLE 30.—*Essential data in 1,086 injuries to major arteries, Seventh U.S. Army, 15 August 1944–30 April 1945*

Artery	Injuries	Amputations	Deaths
Carotid	10	5	4
External carotid	2		
Subclavian	10	2	2
Axillary	19	6	1
Brachial	198	31	
Radial	67	3	
Ulnar	39		
Radial and ulnar	17	8	
Common iliac	3		
Internal iliac	1		
External iliac	18	5	1
Femoral	155	70	1
Superficial femoral	34	19	
Profunda femoris	22		
Superficial femoral and profunda femoris	1	1	
Popliteal	179	125	
Anterior tibial	94	3	
Posterior tibial	153	7	
Anterior and posterior tibial	46	30	
Posterior tibial and peroneal	5	2	
Anterior and posterior tibial and peroneal	1	1	
Peroneal	7	1	
Renal	2		2
Aorta	3		2
Total	1,086	319	13

was situated at, or near, an important vascular anastomosis; whether circulation was still active in the limb when the patient was first seen; and whether thrombi had already formed.

Amputations

Exclusive of immediate traumatic amputations, the collected figures show that, in Seventh U.S. Army hospitals, 1,211 major amputations were performed on Army personnel, in addition to 252 amputations on non-Army personnel, and 277 amputations in which the origin of the casualties was not stated (table 31). If the first and third of these groups are considered as though they were composed entirely of U.S. Army personnel, the ratio of amputations to battle casualties would be 1:40.9 in the 55,058 hospital admissions for battle-incurred injuries on which data were personally collected. If nonbattle casualties are included the ratio would be 1:53.6. These high ratios are explained by the numbers of landmines encountered during offensive operations, particularly in the fighting in November and December 1944 and March 1945.

munications zone, but there were only four known instances in the army area in which both eyes were lost, which is remarkably low, in view of the nature of modern combat. It is possible that some eyes had to be removed in hospitals in the communications zone.

The collected figures show that 193 enucleations or eviscerations of injured eyes were performed in 189 patients, which is 0.32 percent of the approximately 60,000 admissions for battle-incurred injuries officially reported in the Seventh U.S. Army. An additional 136 enucleations or eviscerations were performed in prisoners of war and non-U.S. Army personnel. Whenever it was feasible, a glass sphere was implanted in Tenon's capsule after the eye had been removed.

ANAEROBIC INFECTIONS

In World War I, excluding wounds due to chemical warfare, there were—

> * * * 128,205 wounds of the soft parts with 9,719 deaths; of the wounded in this group, 1,389 developed gas gangrene, which amounts to only a little more than 1 percent (1.08). The death rate among those who received wounds of the soft parts which became complicated with gas gangrene was 48.52 percent, the actual number of deaths being 674.
>
> Among the 25,272 whose wounds included bone fracture there were 2,751 deaths. The incidence of gas gangrene among the bone fracture cases was much higher than among those who sustained wounds of the soft parts only, the total being 1,329 with 593 deaths. The incidence in this group of the wounded was therefore 6.26 percent and the case mortality rate 44.66 percent.[10]

The combined incidence of gas gangrene in these two groups of World War I casualties (153,537) was thus 1.8 percent.

In World War II, the situation was very different, though, unfortunately, the records do not differentiate between anaerobic cellulitis and anaerobic myositis. By 1 November 1944, 24 anaerobic infections had occurred in U.S. Army personnel, with 2 amputations and 10 deaths, and 47 such infections had occurred in undifferentiated personnel, who may have included U.S. Army personnel, with 15 amputations and 2 deaths.

From the end of November 1944 until the end of April 1945, there were 152 anaerobic infections in U.S. Army personnel, with 90 amputations and 38 deaths; over the same period, there were 46,630 U.S. Army battle casualties. The incidence of anaerobic infections during this period is thus 0.3 percent, and the case fatality rate for this type of infection, 25 percent.

Between November 1944 and April 1945, there were also 93 instances of anaerobic infection in personnel other than Army personnel, with 40 amputations and 15 deaths.

The very considerable improvement in respect to the incidence and results of gas gangrene in World War II can be explained in several ways. Anti-

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[10] Coupal, James F.: Pathology of Gas Gangrene Following War Wounds. *In* The Medical Department of the United States Army in the World War. Pathology of the Acute Respiratory Diseases, Gas Gangrene Following War Wounds. Washington: U.S. Government Printing Office, 1929, vol. XII, p. 412.

toxin was used in some cases, but the results were not convincing. Earlier surgery, routine complete debridement, transfusions of whole blood, and the use of penicillin undoubtedly played a part in the improved results. The chief credit, however, is attributable to the performance of good surgery by well-trained surgeons, who were available in far greater numbers in World War II than in World War I.

The cases of clostridial infection known to have occurred in non-U.S. Army personnel were attended with a much higher case fatality rate than those which occurred in U.S. Army personnel, as might have been expected, since the great majority of casualties in this group were prisoners of war who had been wounded and had been without treatment for many hours before they arrived in Seventh U.S. Army hospitals.

BURNS

The 1,284 burns which were included in the statistics collected in forward hospitals in the Seventh U.S. Army were chiefly produced by field ranges and similar equipment. A few phosphorus burns were encountered in the winter and spring. Routine treatment consisted of the application of petrolatum-impregnated gauze and pressure dressings.

CHAPTER XIX

Eighth U.S. Army

Frank J. McGowan, M.D.

SURGICAL MANPOWER

The surgical treatment in the Eighth U.S. Army area of soldiers wounded in combat was carried out in portable surgical hospitals, evacuation hospitals, and field hospitals. The surgical training of men in the evacuation hospitals was, in general, good. There were, however, marked differences in individual abilities among these surgeons. The surgical abilities of the staff of the field hospital were, on the other hand, of a definitely lower quality, and, in the author's experience, the field hospital did not function at all well. It is a matter of record that the actual frontline surgery was, for the most part, performed by clearing companies reinforced by portable surgical hospitals with accompanying surgical teams. This was certainly the case in the Battle of Leyte, the Battle of Zig Zag Pass on Luzon, the operations on Bataan, the retaking of Corregidor, and the lower Visayan operations, which were conducted wholly by the Eighth U.S. Army and involved 51 amphibious landings on two dozen islands.

The Eighth U.S. Army took over the battle for Leyte (p. 477) on 26 December 1944 at a time when the Leyte campaign was declared strategically closed. The subsequent mopping-up operation, which was handled by the Eighth U.S. Army, accounted for 26,000 dead Japanese.

At the time when the Battle of Leyte was being fought in the region of Carigara and the Ormoc Corridor, the forward care of the wounded was done entirely by portable surgical hospitals and clearing companies. The 58th and the 36th Evacuation Hospitals were some 15 to 20 miles in the rear. Evacuation to these hospitals was extremely difficult because of the condition of what were called roads, the constant rains, one-way bridges, and the movement of supplies in the opposite direction.

In the XI Corps landing in the region of Subic Bay, which was quickly followed by the Battle of Zig Zag Pass, the situation was again practically the same. There were two portable surgical hospitals up forward some 2 or 3 miles behind the lines. After 5 to 7 days, the 36th Evacuation Hospital was established some 15 miles to the rear. There was, of course, no transportation after darkness, so here again the brunt of the primary surgical treatment of all types of war wounds was carried on by the portable surgical hospitals and a separate clearing company reinforced by surgical teams.



FIGURE 96.—Col. Frank J. McGowan, MC, Consultant in Surgery, Eighth U.S. Army.

When Corregidor was retaken, the medical support furnished during the first week consisted of the organic regimental medical detachment which had jumped with the parachutists, plus one portable surgical hospital which made the subsequent amphibious landing on the beach. The day after this landing, the commanding officer of the portable surgical hospital was evacuated because of epidemic hepatitis. These two medical units were consolidated on the "Top of the Rock" and, in the days to follow, were strengthened by the addition of several surgeons. This same procedure was rather typical of the actual situation in regard to the mechanism of handling the wounded during the remainder of the Visayan operations, which ended with the fall of Davao City in Mindanao.

These small units, therefore, in the experience of Col. Frank J. McGowan, MC, Consultant in Surgery, Eighth U.S. Army, (fig. 96) bore the brunt of the surgical treatment of the wounded soldier. They were manned by young men with little surgical experience, and the presence of a well-trained surgeon in these units was the exception rather than the rule. The majority of well-qualified men, and by that is meant men who had attained or were qualified for the rating of the American Board of Surgery, were to be found in the general hospitals and in the evacuation hospitals.

Evacuation hospitals were designed to function early. However, in many instances, due to difficulties in terrain, overwhelming difficulties in transportation, and the rapid movement of tactical units, they were never in a position to receive cases until late in an operation (fig. 97). This was especially true during the Battle of Zig Zag Pass.

Many incidents contributed to failure in otherwise well-laid plans. For example, on Cebu Island, Japanese mines on the beachhead delayed the early establishment of an evacuation hospital, although its personnel were used. Casualties were high, and hospitalization facilities, consisting of a division clearing company plus personnel from the 58th Evacuation Hospital, were swamped with patients. Again, within a very short time after the landing on Mindanao at Polloc Harbor, the combat troops advanced so far over difficult terrain that they outstripped the two evacuation hospitals by some 75 to 100 miles. In the southern Philippines campaign for Mindanao, one portable surgical hospital en route to the Davao area was ambushed by the enemy, its equipment was destroyed, and the commanding officer was seriously bayoneted.

The lives of wounded soldiers were saved in forward medical units and not in the rear hospitals. Wounded soldiers rarely arrived in rear hospitals until from 7 to 10 days after the time of injury, a demonstration of their ability to survive and travel. Proper treatment, if afforded early, saved many lives, minimized complications, and shortened future care. These remarks are made with particular reference to the SWPA (Southwest Pacific Area) with its isolated islands, its great difficulties in transportation, and an average medical strength which was always below authorized strengths. This deficiency in personnel was further complicated by the theater policy of separating nurses from their units before moving into combat zones. In the European theater, nurses accompanied their units on the Normandy invasion. The policy of separating the nurses seriously affected those units which had trained with their complement of nurses, especially as the enlisted personnel replacements, supposedly on a basis of two enlisted men to one nurse, were never supplied in that ratio and were, in most instances, badly lacking in training. The consultant could never understand why army nurses were not allowed to join their units on D+3 or D+4 or just as quickly as there was local security. The casualty load was heavy, and the nurses would have contributed greatly to the increased efficiency of all surgical units. As it worked out, they were shuttled about in the rear areas, and those complements of nurses that finally caught up with their units did so at a time when the casualty load was low and the unit was on the verge of becoming inactive (fig. 98).

The Eighth U.S. Army conducted the Visayan operations which Gen. Douglas MacArthur called "a model of what a light but aggressive command can accomplish in rapid exploitation." This campaign called for task forces up to the size of an army corps (X Corps, Mindanao), each of which had to



FIGURE 101. Administration of plasma to patient during litter carry, Mindanao.

acted as an evacuation hospital ship (fig. 103). These LST's received patients during daylight hours, pulled offshore at dusk, and remained at sea during the night. They had U.S. Navy surgical teams. These teams consisted rarely of well-trained surgeons. Colonel McGowan would advise augmenting the staffs of these LST hospitals with well-trained surgeons from the Army to do the surgery on these ships. An ophthalmologist and a neurosurgeon were required in the surgical team. On Luzon, in the XI Corps action (Zig Zag Pass, Bataan, Corregidor), there was no trained ophthalmic surgeon. Fortunately, Colonel McGowan located a U.S. Navy medical officer trained in ophthalmology who served as a consultant. In the author's opinion, close cooperation between the Medical Corps of the Army and the Navy in amphibious warfare was vital. Only thoroughly trained personnel should be entrusted with the receiving and disposition of casualties.

On many landings, the LST's were storage places for units of whole blood. The stored, refrigerated blood should have been packed by plan, with a medical officer responsible for its care, screening, and distribution. Too often, blood was distributed haphazardly throughout a convoy and was difficult to locate (fig. 104). The handling of whole blood was much more efficient when a responsible person was in charge.

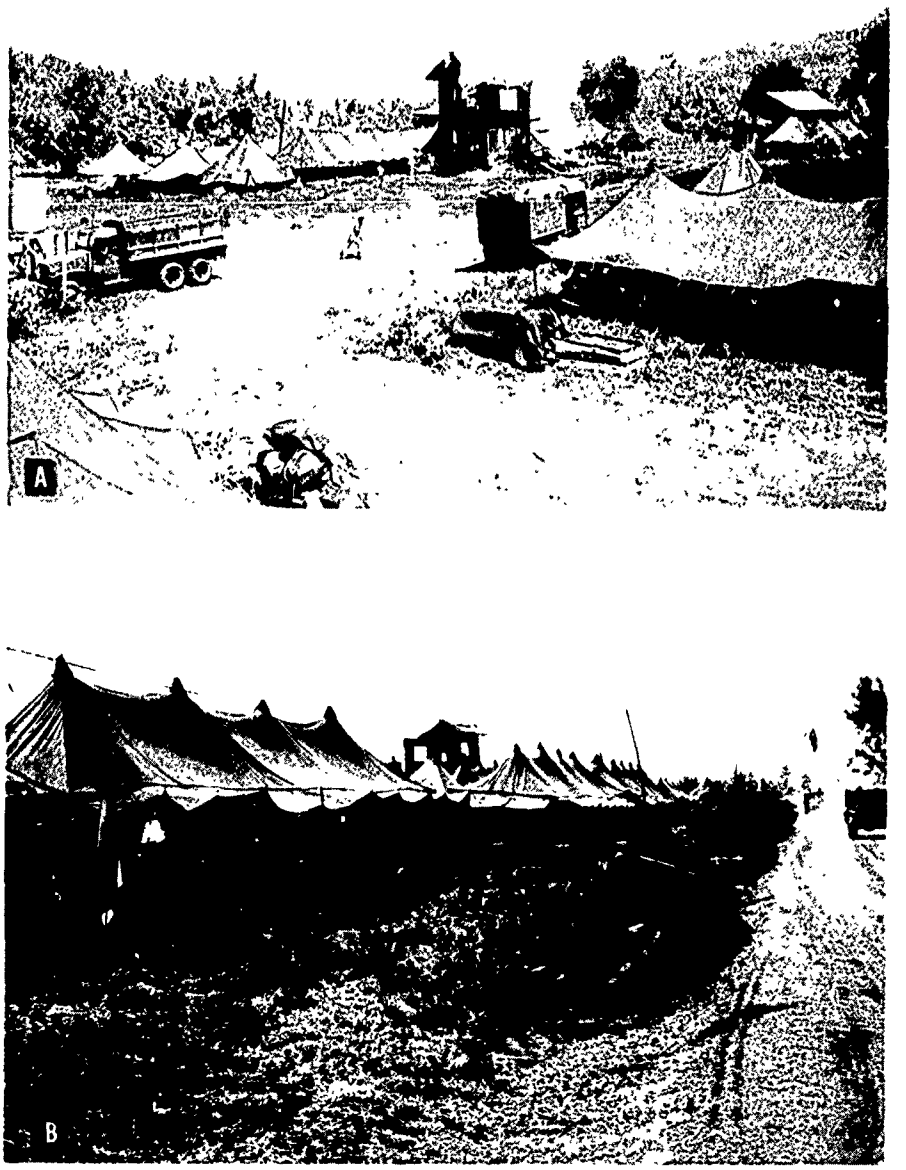


FIGURE 97.—The 30th Evacuation Hospital at Parang, Mindanao, Philippine Islands. A and B. External views of hospital area, 21 April 1945. Dust from main supply route covered patients and facilities.

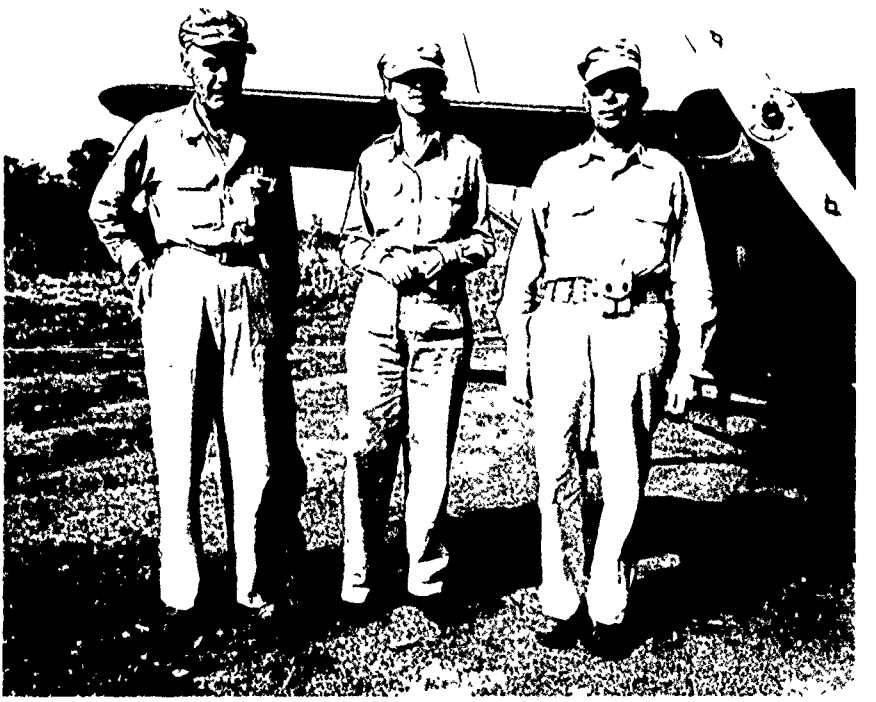


FIGURE 98.—Maj. Margaret D. Craighill, MC, adviser to The Surgeon General on women's health and welfare, arrives at Parang, Mindanao, with Col. George W. Rice, MC, Surgeon, Eighth U. S. Army, to investigate the use of female Army personnel in the X Corps. At left is Colonel McGowan.

EFFECTS OF TERRAIN, CLIMATE, AND LOCAL CONDITIONS

The terrain, for the most part, was extremely difficult. This was particularly so in the Battle of Leyte where conditions were frankly indescribable. Contributory to this were the poor roads, torrential rains, one-way bridges, and so forth.

The climate, in general, was extremely hot. It was imperative of course, that all drinking water be chemically treated. On Leyte, particularly, it was impossible to carry out any foot hygiene among the troops fighting in the mountain passes.

On 24 November 1944, Colonel McGowan saw approximately 100 cases of immersion foot at the 58th Evacuation Hospital. These men had been in their foxholes for 2 or 3 weeks and were utterly exhausted. On the same day, he saw between 50 and 100 similar cases at the 36th Evacuation Hospital. Indeed, it was even difficult to supply these combat troops with rations and ammunition. Evacuation in the early days of the Leyte campaign was a frightful problem. Colonel McGowan saw one group of 50 wounded (Ormoc Corridor) who had been 3 days in transit with no food.



FIGURE 99. On the morning of Task Force X–Ray's landing on Green Beach, Parang, Mindanao, Colonel McGowan confers with Col. C. McC. Downs, MC, Surgeon, X Corps.

The author landed on Corregidor on 18 March (the initial landing had been on the 16th) with about 100 pints of blood some fresh blood from the 36th Evacuation Hospital and some old blood from a hospital ship in Subic Bay. He found the 1st Portable Surgical Hospital on the beach, and that afternoon, when the top of the Rock was first reached, he found scores of fractures, the majority of which were compound. The 503d Parachute Regiment had jumped 2,100 men of whom 182 had been injured. The third wave of jumpers had been machinegunned by the Japanese. These were the rough figures given at the regimental command post at that time. The fractures found had resulted from the jump.

Colonel McGowan organized a surgical setup consisting of the 1st Portable Surgical Hospital and the 503d Regiment's medical detachment and began to operate. At about 2300, water ran out and plaster could not be used.

During that night, the first of the tunnel explosions occurred with many casualties. There was much firefighting about the building. Here, one of the difficulties due to terrain was the lack of water as the Rock was to be supplied by a water boat which had not come in. Ambulance evacuation down to the beach was under small arms fire, and one convoy was turned back.

It was interesting to note that none of the cases of compound fracture of the femur, untreated for 48 hours, went into shock when debrided and immo-

bilized and that no bad effects were noted from the use of the outdated blood obtained from the hospital ship.

The line of evacuation from Corregidor was as follows: From the top of the Rock by ambulance to the beach; from the beach by LCM (landing craft, mechanized) and LST (landing ship, tank) to Subic Bay; by ambulance from the bay to the 36th Evacuation Hospital. There were eventually on Corregidor one large operating room with three tables, a plaster room, a recovery ward, and a good surgical team.

EVACUATION OF CASUALTIES

The methods of evacuation ranged all the way from native litter bearers to Ducks (single-engine, general-purpose amphibian airplanes), ambulances, watercraft, and air evacuation planes—L–5B's which could accommodate one litter or one sitting patient and C–47's. There were all manners and combinations of these.

Evacuation of casualties by C–47's implied the necessity for a condition of security for the most part. Evacuation by L–5B's, while tedious because of the limited carrying capacity and range of the planes, was of extreme value in Colonel McGowan's experience because it could be carried out when there was no security and was lifesaving in many situations where evacuation by road was impossible. For instance, during the Battle of Zig Zag Pass, the 64th Portable Surgical Hospital found itself entirely cut off in the Dinalupihan area. The staff had been operating for days on all types of war injuries, had about run out of supplies, was crowded with postoperative cases, and was running short of food. Colonel McGowan took a surgeon from the 36th Evacuation Hospital and three L–B's from the airstrip at San Marcelino, Luzon, landed near the hospital, and set up an evacuation scheme whereby, in 48 hours, it was possible to remove all of the wounded.

The maintenance of close contact between the hospitalization and evacuation sections in the army surgeon's office was necessary in order to avoid the dangerous piling up of wounded soldiers in forward areas. Evacuation of the wounded from the frontlines by light aircraft was frequently resorted to by the Eighth U.S. Army during the Visayan operations and was responsible for the saving of many lives. Evacuation by C–47 or C–46 hospital plane of postoperative patients from small islands with limited medical facilities to larger bases on neighboring islands kept the forward zone in a fluid state and prevented the accumulation of postoperative cases where their care would seriously hamper the already overtaxed personnel (fig. 100). Considerable credit must be given to the sergeant pilots who flew the light aircraft. Had more planes been available at the time, much more effective work could have been accomplished in the care of the wounded.

From the experience with these and other situations where aircraft were used in the evacuation of battle casualties, the author was strongly of the

opinion that air evacuation of the wounded should be under the control of the army surgeon or his representative, and not a function of G–4 (logistics (supply)). In several situations, where aircraft of both types were set up for evacuation of the wounded by G–4, there was the temptation to use these aircraft for the transport of nonmedical freight, a practice which interfered with the schedule set up for evacuating patients.

SURGICAL SUPPLIES AND WHOLE BLOOD

In general, the medical and surgical supply situation was adequate. At times, when there were temporary failures of supply, those failures were due to circumstances beyond anyone's control.

The author would like particularly to compliment the Army and the Navy authorities on their whole blood program. The blood began to arrive on Leyte in November 1944. It was well packaged with 16 units of whole blood to a container in which were 17 pounds of cracked ice. The accompanying tubing was reaction proof. With the advent of these units, transfusion of whole blood became as simple to administer as plasma had been, and more and more whole blood was used. Up to this time, the surgeons had been prone to use plasma rather than whole blood because plasma had been much easier to administer and its value had been too enthusiastically stressed (fig. 101). To a large extent, they were using a makeshift type of tubing and methods which led to frequent clotting, reactions, and other unfavorable results. Throughout the entire Leyte campaign and subsequent to it, Lt. Col. Frank Glenn, MC, Consultant in Surgery, Sixth U.S. Army, and Colonel McGowan insisted upon the use of whole blood whenever possible.

PORTABLE SURGICAL HOSPITALS

Portable surgical hospitals were originally set up for jungle warfare where larger units could not operate (fig. 102). Their chief weaknesses, which were obvious toward the close of the campaign in the SWPA, were:

1. The mediocre abilities of the professional personnel—to which generalization there were some outstanding exceptions—and the many replacements resulting from rotation.

2. The lack of equipment which seemed adequate on paper but was woefully lacking when it is realized that these small units practically bore the brunt of frontline definitive surgery. They had no generator, no electrical illumination, no refrigeration, no suction apparatuses, and no resuscitation equipment.

3. In the press of work, they were not set up to function independently. Consequently, as often as Colonel McGowan could, he insured that they were attached to separate clearing companies and reinforced with surgical teams.



FIGURE 100 (*See opposite page for legends.*)



FIGURE 100. Evacuation by C-47 aircraft from Malabang airstrip, Mindanao. A. First load of patients to be evacuated from Malabang arrive at planeside on 28 April 1945. B. View of litter patient being loaded into C-47. C. Interior of loaded C-47.

SURGICAL TEAMS

In the SWPA, there were none of the auxiliary surgical groups which proved of such great value in the European theater. Col. William B. Parsons, MC, organized a series of surgical teams to be taken from rear echelon units and put at the disposal of army medical units for the purpose of augmenting these units when in combat. These surgical teams consisted of two surgeons and six enlisted men. After Colonel Parsons left the SWPA, Col. I. Ridgeway Trimble, MC, carried on this excellent scheme.

In this consultant's experience with these teams in Subic Bay, Corregidor, Bataan, and the Leyte campaign, he occasionally encountered a team of two well-trained surgeons and six well-trained enlisted men. Too often, the rear echelon units busied themselves with convalescent patients, and, unaware of the demanding situations of the combat zone, sent their less trained medical officers and enlisted men to the front.

MEDICAL SUPPORT IN AMPHIBIOUS WARFARE

In general, the plan for an amphibious assault was to have one or more LST's, especially equipped as hospital ships, support the landing until the beach was secure and the evacuation hospital was established. Each LST then



FIGURE 101. Administration of plasma to patient during litter carry, Mindanao.

acted as an evacuation hospital ship (fig. 103). These LST's received patients during daylight hours, pulled offshore at dusk, and remained at sea during the night. They had U.S. Navy surgical teams. These teams consisted rarely of well-trained surgeons. Colonel McGowan would advise augmenting the staffs of these LST hospitals with well-trained surgeons from the Army to do the surgery on these ships. An ophthalmologist and a neurosurgeon were required in the surgical team. On Luzon, in the XI Corps action (Zig Zag Pass, Bataan, Corregidor), there was no trained ophthalmic surgeon. Fortunately, Colonel McGowan located a U.S. Navy medical officer trained in ophthalmology who served as a consultant. In the author's opinion, close cooperation between the Medical Corps of the Army and the Navy in amphibious warfare was vital. Only thoroughly trained personnel should be entrusted with the receiving and disposition of casualties.

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FIGURE 102.—Operating scene, 23d Portable Surgical Hospital.

TREATMENT OF PARTICULAR TYPES OF WOUNDS

The treatment of war wounds has been well covered elsewhere as a result of the extensive data which came out of the war theaters. The author, however, would like to stress some of the following observations with respect to the treatment of regional injuries—observations based on his experience as the surgical consultant, Eighth U.S. Army.

Abdominal injuries.—There must be routine use of gastric drainage with adequate supportive therapy through the liberal use of blood and plasma. Wire sutures should be employed to close the abdominal wall in serious cases. There should be more frequent use of transverse and oblique incisions.

Chest injuries.—The earlier diagnosis of massive hemothorax must be urged. Open thoracotomy should be resorted to as soon as it is indicated and, in general, sooner than it was done. More intelligent use of morphine is required. The surgeon has to distinguish between the restlessness due to the lack of oxygen and real pain.

Wounds and injuries of the femur.—Thorough but not too radical debridement must be practiced and must be followed by the application of a double-leg spica plaster. Medical officers should appreciate the fact that

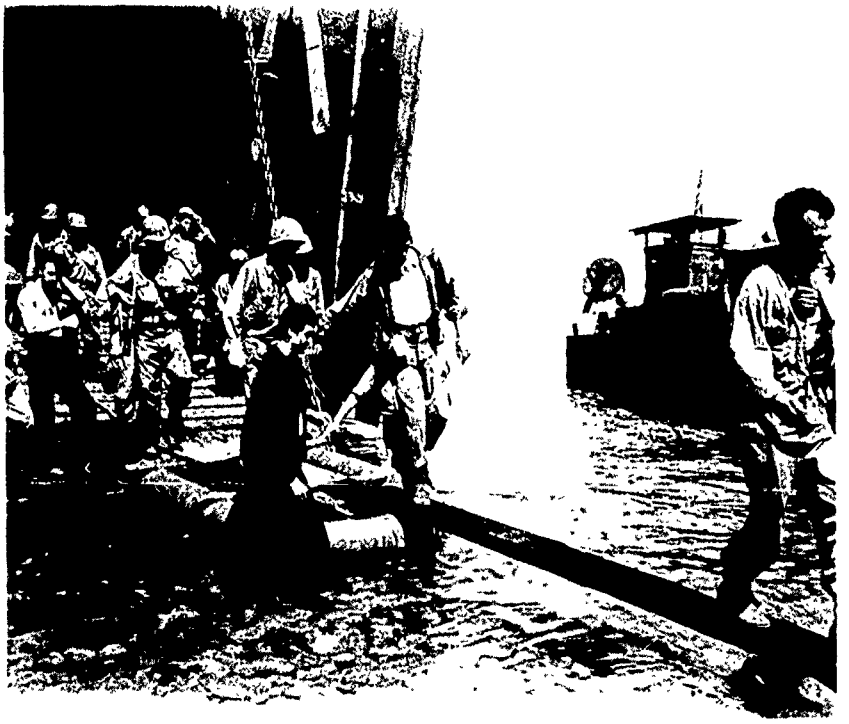


FIGURE 103.—Casualties debark from an LST hospital ship at Corregidor Island in March 1945.

a limb-saving debridement is a challenge to the good surgeon and more difficult to perform than a guillotine amputation.

RECOMMENDATIONS

In the event of any future war, it will be necessary to place well-qualified surgeons in forward medical units in order to improve the care of casualties. Well-qualified surgeons may be temporarily attached to hospitals actively engaged in the support of combat operations. This attachment could be handled as it was in the European theater by the employment of auxiliary surgical groups. Various specialists should be assigned to the forward areas, and the general surgeons in these areas should be capable of performing major surgical operations.

Newly arrived medical officers should be attached for training and orientation to active general hospitals at an early date. The newly arrived should also be attached to more forward units for proper orientation and experience in actual combat, but the combat zone is not the place to train surgeons in the fundamental principles of war surgery.



FIGURE 104 The 99th Evacuation Hospital, combat loaded on top deck of LST at Morotai before the V 5 operations in the southern Philippines campaign.

The foregoing implies machinery for rotating medical personnel between army and communications zone units. Flexibility in handling personnel should be the constant aim of army and communications zone authorities. Surgeons from the rear echelons rapidly changed their ideas concerning proper surgical management of battle wounds after having participated in frontline surgery. The Eighth U.S. Army surgical consultant resorted to this practice of rotating surgeons, but, in retrospect, it should have been done more frequently.

Early during Colonel McGowan's tour of duty in the SWPA and shortly after he reached Leyte, the following notes were written:

1. Army medical units in the SWPA had not been appraised professionally. This was particularly true of units just arriving from the United States or from another theater.

2. There was no professional supervision by the corps or division surgeons of the work being done.

3. Surgical consultants were asked with practically no authority to correct or supervise work. This situation was corrected later, and the author can report personally that his own endeavors in this respect met with the fullest cooperation on the part of Col. (later Brig. Gen.) George W. Rice, MC, Surgeon, Eighth U.S. Army. Many of the medical units assigned to armies had

undergone long training in the Zone of Interior and many inspections as to equipment, ability to set up in the field, et cetera. However, to the best of the author's knowledge, none of these units had had an evaluation of their ability to perform good surgery.

The author would strongly recommend that, in the future, under circumstances similar to those which existed in the Eighth U.S. Army during World War II, surgical consultants be regularly assigned to each army corps, and, as frequently as becomes necessary, a consultant be assigned to each division in combat.

APPENDIX A

Civilian Consultants in Surgery to The Surgeon General

The following specialists served as civilian consultants to The Surgeon General:

Anesthesiology:
- Dr. Joseph Kreiselman

Aural Rehabilitation:
- Mr. Charles E. Harrison
- Dr. S. Richard Silverman

General Surgery:
- Dr. Harvey B. Stone

Hand Surgery:
- Dr. Sterling Bunnell

Neurosurgery:
- Dr. Claude C. Coleman
- Dr. Loyal Davis
- Dr. W. Jason Mixter

Ophthalmology:
- Dr. F. Phinizy Calhoun
- Dr. Frederick C. Cordes
- Dr. Harry S. Gradle
- Dr. Alan C. Woods

Orthopedic Surgery:
- Dr. LeRoy C. Abbott
- Dr. Carl E. Badgley
- Dr. Guy A. Caldwell
- Dr. Harold R. Conn
- Dr. H. Earle Conwell
- Dr. William Darrach
- Dr. Franklin D. Dickson
- Dr. Albert Key
- Dr. Guy Leadbetter

Orthopedic Surgery—Continued
- Dr. Paul Magnuson
- Dr. Earl D. McBride
- Dr. Oscar L. Miller
- Dr. Frank R. Ober
- Dr. W. W. Plummer
- Dr. Robert D. Schrock
- Dr. M. N. Smith-Peterson
- Dr. John C. Wilson
- Dr. Philip D. Wilson

Otolaryngology:
- Dr. George Bennett
- Dr. John MacKenzie Brown
- Dr. Albert C. Furstenburg
- Dr. Walter Hughson
- Dr. Dean McAllister Lierle

Plastic Surgery:
- Dr. Louis T. Byars
- Dr. John Staige Davis
- Dr. Robert H. Ivy
- Dr. George Warren Pierce
- Dr. Jerome P. Webster

Surgical Photography:
- Mr. Milton Traubner

Thoracic Surgery:
- Dr. John Alexander
- Dr. Evarts Graham

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APPENDIX B

HEADQUARTERS SEVENTH ARMY
Office of the Surgeon
APO 758 US Army

18 JULY 1944

CIRCULAR LETTER NO. 2

SUBJECT: Surgery.

General	1
Echelons	2
Morphine	3
Tetanus	4
Surgical Procedures	5
Plaster Casts	6
Plasma and Blood	7
Sulfonamides and Penicillin	8
Infections	9
Burns	10
The Patient	11

1. The surgical policy that will be followed is a development of those principles and modes of Therapy that have been developed and established by NATOUSA throughout the past eighteen months. Full use will be made of a vigorous transfusion-resuscitation program by the establishment of blood banks within each hospital unit with the assistance of the Army Blood Bank (Sec. VII) and the mobile laboratories. Control of infection will be strengthened by the use of penicillin, which will be available in sufficient quantities so that treatment may be continuous from the Field Hospital to the Base. Treatment of the patient must be considered as a continuous unified effort with utmost cooperation and clarity of treatment and records by each echelon concerned. A combination of the saving of life and limb with early restoration of function and return to duty should be the aim of all installations.

2. *Surgical Echelons.* Extract from NATOUSA Circular on Forward Surgery:

"a. The welfare of the patient and the tactical necessity for rapid, yet safe, evacuation, demand a clear understanding of the function or mission of each unit of the Army Medical Department. This is best arrived at by dividing the treatment of a casualty into two stages—primary and definitive. Separate groups of units provide each stage of treatment. In general, the equipment of each group is designed for its particular purpose only.

"b. Aid Stations, Collecting Stations, and Clearing Stations (First and Second Echelons) are equipped and staffed to render the primary phase of treatment. Arrest of hemorrhage, splinting, resuscitation measures needed to make the patient transportable, and administration of sulfonamides, are the prime functions of these stations. In addition, the treatment of minor injuries is carried out without evacuation. A Clearing Station is not designed to provide definitive treatment of battle casualties."

c. A proportion of admissions will be *nontransportables.* A nontransportable is a patient that cannot be evacuated farther without real danger to life and limb. (FM 8–10, par. 65c.) These patients will be transferred immediately to the attached Field Hospital Unit in support of the Clearing Station. No surgery will be performed forward of the Field Hospital.

d. Third Echelon units, Field and Evacuation Hospitals, with attached Surgical Teams, are designed to initiate surgical treatment of battle casualties. Every effort

should be made to deliver casualties requiring hospitalization to these units as quickly as possible so that lives may be saved, proper surgical care instituted, and convalescence shortened.

(1) The Field Hospital Units supporting Division Clearing Stations are equipped to care for non-transportable casualties. These consist of two groups: First, those suffering from grave life endangering physiological disturbances, such as hemorrhage, severe shock, cardiorespiratory imbalance from wounds of the pericardium or large sucking wounds of the chest, intra-cranial pressure, and certain maxillo-facial or neck wounds in which there is obstruction to respiration. Second, there is the group of impending fulminating infections; this includes all thoracoabdominal and abdominal wounds or wounds in other areas that may have penetrated the abdomen, such as wounds of the buttocks and thighs; extremity wounds with severe vascular injuries or evidence of gas infection, major traumatic amputations, and compound fractures of the long bones with extensive soft part damage.

(2) The Evacuation Hospitals are of two types: The semi-mobile 400-bed, and the 750-bed installations. To these are transported all cases not requiring the first priority urgent surgery of the Field Hospital units, and also medical and venereal patients. At times certain of these units may be used for specialized triage purposes.

3. *Morphine.* An initial dosage of morphine sulfate, gr. ¼ (0.015 gms.) is sufficient. Doses of gr. ½ (0.030 gms.) are too large; such dosage causes too great respiratory depression, is definitely bad for intra-cranial and maxillo-facial lesions, and accomplishes no more than the smaller dose in abdominal and chest casualties. Whenever morphine is administered, the amount and time will be clearly recorded. Morphine, when given subcutaneously, is poorly and slowly absorbed in patients who are in shock; therefore, repeated administration in such cases is fraught with real hazard, for, as recovery from shock ensues, absorption of the accumulated amounts may be rapid and morphine poisoning result. This danger may be avoided in such patients in shock by a single dose of gr. ⅛ (0.010 gms.) to gr. ¼ (0.015 gms.) given intravenously, *never more.*

4. *Tetanus.* A stimulating dose, 1 cc., of tetanus toxoid will be given to all casualties in first or second echelon units. This dose will be recorded in the EMT Tag. To date there has been only one (1) case of tetanus in the U.S. Army in this Theatre.

5. *Surgical Procedures.*

a. *Dressings.* After initial application, dressings will not be disturbed until the Field or Evacuation hospital is reached, except for hemorrhage. They are inspected at each stop along the line of evacuation, however, and splints readjusted or dressings rearranged when necessary. Frequent and unnecessary change of dressings increases the risk of hemorrhage and infection and also increases time-lag from wounding to initial surgery. "Innumerable sufferers in every war have been bandaged into their graves at the hands of over-enthusiastic dressers." (Jolly)

b. *Tourniquets.* Tourniquets are seldom necessary and frequently misused. When applied properly for otherwise uncontrollable hemorrhage, a tourniquet may be a life-saving measure. When improperly applied, however, bleeding is increased and complete exsanguination may occur. The sole indication for their use is active spurting hemorrhage from a major artery. For hemorrhage from veins and lesser arteries a small pack and bulky pad bandaged snugly over the bleeding point will almost always suffice. To date the tourniquet has been used with good judgment by Aid Men and Battalion Surgeons. In applying the tourniquet, if rubber tube or bandage is employed, 2 or 3 turns are made about the limb stretching the rubber between each application. The knot or ends are then to be made fast so as to prevent any slipping. The limb is observed for a few moments to be sure that hemorrhage has ceased. If not, the tourniquet must be readjusted and tightened. Unless the tourniquet is so applied as to accomplish its purpose of *stopping* hemorrhage, it is not only useless, but harmful, and may well cost a life rather than save one. When non-elastic material and Spanish windlass mechanism is used, a firm

pad or roll of bandage is placed over the course of the artery, one turn of the tourniquet made about the limb, and the tourniquet tightened until all bleeding stops. The windlass is secured so that no relaxation occurs, and the limb observed for a few minutes. Do not apply a tourniquet directly over the skin, if possible. Leave a layer of clothing or towel in place. Whenever a tourniquet has been applied, this will be so noted in CAPITALS on the EMT Tag and the reason therefor stated as a guide to all stations to the Field Hospital.

c. *Amputations.* The policy on amputations is one of conservatism. Every effort will be made to save and give the limb a chance. The prompt administration of penicillin, meticulous debridement, and possible paravertebral sympathetic block will help. Amputations will always be performed at the lowest possible level. They will be circular, the incision passing through each tissue layer at the level of retraction of the next most superficial layer; i.e., skin, deep fascia, muscles, bone, no primary suture. A loose covering of fine mesh dry or [petrolatum-impregnated] gauze will be placed over the surface and skin traction down to the skin edge applied immediately. 5–10 pounds are used. When applied evenly this has the beneficial effect of an even pressure dressing. Packing will *Not* be used. In lower leg amputations some type of posterior splint from midthigh to beyond the stump is provided to prevent contracture at the knee. A Thomas splint or plaster cuff with wire cage may be used for attachment of traction. No skin grafting or secondary suture will be performed in army installations. The object of amputation for trauma is the saving of life and as much limb length as possible. Every inch saved is of great value in forming the final useful stumps. This, however, must be left to Base and ZI Units.

d. *Debridement of Wounds.* Careful attention will be given to Circular Letter, No. 26, Office of the Surgeon, NATOUSA, 19 April 1944, Subject: Wound Management. "The keystone of successful wound management is the initial surgical operation. When this is performed correctly the complications of infection are absent or minimal and secondary suture may be carried out promptly and successfully." Chemotherapy is an adjunct and can never be substituted for meticulous, complete, proper initial surgery. Good light and wide incision to provide amplo exposure are necessary to permit adequate removal of damaged underlying tissues. A team of two is far superior to the single operator. All foreign matter, loose and unattached bone fragments, damaged muscles, and fascia must be removed at the initial procedure. An absolute minimum of skin is removed and wounds are never circumcised. *No primary suture, except of cranial wounds and some wounds of the face.*

(1) *Head wounds* are to be transferred promptly to an Evacuation Hospital unless there are signs of intracranial pressure or uncontrollable hemorrhage, when they will go direct to a Field Hospital.

(2) *Eyes.* One (1) percent atropine is to be instilled, an anesthetic bland ointment, such as butyn metaphen smeared liberally in the eye, and across the lids, and a pressure dressing held snugly in place with overlapping strips of adhesive applied. The patient is then sent to an Evacuation Hospital. Here a conservative policy will be pursued and every effort made to preserve the eye. There is no danger of sympathetic ophthalmia within the first 3 weeks after injury. Therefore, unless there is danger from infection or hemorrhage, great conservatism will be practiced.

(3) *Maxillo-facial.* Ensure an adequate airway and transfer sitting or semiprone to an Evacuation Hospital. Occasionally it may be necessary to send such a casualty directly to a Field Hospital.

(4) *Chest.* These patients are to be sent as No. 1 priority to a Field Hospital when there is continuing hemorrhage, signs of cardiorespiratory failure, or suspicion of abdominal involvement. Otherwise, transfer to an Evacuation Hospital.

(5) *Abdomen and Thoracoabdominal* cases are all sent direct to the hospital nearest the Clearing Station, usually a Field Hospital. Wounds of the rectum are in-

cluded in this group. Wounds of the buttocks and upper thighs are frequently in this group. A rectal examination will be done on all cases. Blood on the examining finger indicates rectal involvement. A colostomy is performed for all wounds of the rectum, preferably of the simple loop type. In all wounds of the colon, the damaged part is exteriorized, or if the wound is in a fixed portion of the colon, a proximal colostomy is performed. The abdomen is always closed with through and through sutures; the peritoneum and posterior and anterior sheaths may be closed in addition.

(6) *Joints* will be widely opened, meticulously debrided of all foreign matter, dead tissue, loose and ragged fragments of bone and cartilage, and blood clot, and then thoroughly irrigated with saline. The synovia is then closed, a flap of fascia or skin being utilized to close defects when necessary, and 10,000 units of penicillin (250 units per cc. in saline) are injected into the joint. The skin is not to be sutured and *no* drains are to be used into the joint. The limb is then immobilized in plaster. For the knee, the most common and important joint affected, a hip spica is applied. Under periods of great stress a circular upper thigh to lower leg cast may be substituted. For immobilization of the knee this is not as good as the hip spica, but is far superior to the usual lower leg mid-thigh cast, which permits rocking of the joint. The cast will be split.

(7) *Compound Fractures.* Many casualties with compound fractures of the long bones or traumatic amputations are in severe shock or have lost much blood so that prompt resuscitation is necessary. These are transferred direct to the Field Hospitals. The purpose of the forward hospital is not to treat the fracture but to make such casualties transportable to the rear as rapidly as possible where treatment of the fracture will be undertaken. For this reason, only thorough debridement and plaster immobilization of these cases will be carried out in forward hospitals, and parenteral administration of penicillin begun (Sec. VIII). Internal fixation will be used only when it is evident that the circulation will be jeopardized by impingement of the bone ends. Pins incorporated into casts will not be used. They do not transport well. The transportation cast is the safest and most practical and comfortable means for transporting such patients to the rear. These casualties will be given first priority evacuations. Such casts will also be used for extensive soft part injuries without bone or joint damage.

(8) *Nerve Injuries.* Nerves will not be sutured in hospitals of the first three echelons. There are no exceptions.

(9) *Blood Vessels.* Rarely it may be possible to repair wounds of major arteries. If not, they are to be doubly ligated and the damaged portion excised. Never ligate in continuity. The accompanying vein is ligated and divided, adjacent nerve trunks are injected with 1 percent procaine and paravertebral block of the sympathetic chain with 1 percent procaine is performed. This may be repeated at 12-24 hour intervals or sympathectomy decided upon. Cases of major vascular injury will be sent to the nearest unit, generally a Field Hospital.

(10) *Evacuation.* As far as possible, no abdominal, thoracoabdominal, head, or major vascular casualties will be evaculated before the 10th or 12th post-operative day. The same applies to the more serious chest cases. Such patients do not tolerate transportation. Fractures will have first priority.

(11) *Records.* The need for careful, accurate, legible, records is emphasized. A concise, clear description of what is done in each installation is essential for the best uninterrupted and continued care of the patient. The "how, when, and where" of a wound or injury are the first items to be noted. The "when" includes the hour as well as the date of occurrence, and the same applies to the time of arrival in different installations. The type of missile is also noted. It is particularly important to note on the record, and also on the cast, the presence and size of skin defect, the type of fracture, nerve and vessel lesions, and the type of colostomy formed and length of spur when present. Sulfonamide and penicillin therapy as to amount given and whether or not continuance is desired will be stated.

6. *Plaster Casts.* When plaster of paris is used, no circular adhesive or bandage will be applied underneath the cast. All casts are to be padded, and all are to be split throughout their entire length immediately. This splitting must include all layers of circular padding or dressings down to the skin. Unpadded or unsplit casts have no place in forward installations. The foot is to be at right angles to the leg, the knee and hip flexed very slightly, and the toes free. The plantar surface of the cast will extend beyond the toes or a loop beyond the toes made so as to withstand the weight of the bed clothes. In arm cases, the arm is in neutral position, slightly forward, with the wrist and hand supported in neutral position, or in cock-up. Flexion at the wrist is not to be used. Casts with the arm in full abduction or hanging casts, will not be used, as these are very poor for transportation. In third echelon installations, casts are used for transportation purposes as well as for the underlying injury-soft part, or fracture; hence, transportability becomes an important consideration, and the cast applied accordingly. Diagrams, dates of wound and casting, and notes will be written on casts with an indelible pencil.

7. *Plasma and Blood.* Plasma is used in all places from the battlefield itself to the ZI. As a measure of resuscitation, its value rests chiefly in supporting the hemorrhage or shock casualty until he arrives at a station where whole blood is available. It is in no way a substitute for whole blood. Up to 750 ccs. may be given rapidly. After that there is the danger of further diluting an already grave hemodilution. Careful perusal of Circular Letter No. 30, Office of the Surgeon, NATOUSA, 12 May 1944, Subject: Blood Transfusions, is recommended, and its instructions will be followed. An Army Blood Bank Unit will furnish low titre "O" blood to the Field Hospitals. Depending on the demand here, some may be available for the Evacuation Hospitals. This blood may be used for all patients in amounts up to 1,000 or 1,500 ccs. After this, specific type blood should be used. High titre "O" blood will also be available but the use of this must be restricted to "O" recipients. All recipients and donors will be crossmatched. This may be rapidly performed (3–5 min.) by the centrifuge method and doubtful cases checked by the longer slide technic.

a. It is essential that the Evacuation and rear units maintain their own blood banks as outlined in Circular Letter No. 30. Only in this way can adequate supplies of whole blood be assured. Blood will be used judiciously and not wasted. Only the amount needed to bring about adequate resuscitation and carry the patient through his surgery and post-operative period is to be given, for the risk of fatal anuria is not negligible. There will be adequate blood available at first, but the various units will organize their own blood banks as rapidly as possible.

8. *Sulfonamides and Penicillin.* Sulfonamides will be used both locally and orally at the original dressing of the wounded casualty. No further local application will be made until the patient reaches the Field or Evacuation Hospital, though oral administration will be continued. When admitted to these installations all except the certainly trivially wounded will receive an initial injection of 25,000 units of penicillin intramuscularly, which is to be continued on a 3-hour schedule until stopped by the Surgeon. At the first dressing or operation he will decide whether to continue penicillin or sulfonamide. Both will not be used. Instructions given in Circular Letter, NATOUSA, Subject: Penicillin, will be carefully followed.

9. *Infections.* The Clostridial infections comprise the important group that is encountered in forward surgery. Early, careful, thorough surgery, combined with adequate blood replacement and penicillin is the best preventive. Sulfonamide Therapy is of no demonstrable value, either as a preventive or therapeutic measure. Certain facts relating to the incidence should be borne in mind. About three-quarters of the cases are in wounds of the lower extremities. One-half are complicated by fractures, and one-third by vascular injuries. Yet the mortality is lower in these two groups than when only soft parts are injured. Apparently less concern is felt over the possibility of "gas" in this type of wound

and these cases are not recognized early. Jergesen has described the early symptoms as: 1, pain, 2, mental changes, either hyperactive or drowsy and apathetic, 3, rapid pulse out of proportion to temperature, 4, temperature. To these may be added loss of appetite. The most important and common of these is pain, often with strikingly sudden onset. This should call for *immediate* re-examination of the wound and not just a "dose of morphine and drop around later" policy. Inspection of the wound will show swelling, sometimes skin discoloration, muscle changes, possibly the presence of gas, and possibly a putrefactive odor. Early diagnosis may be greatly facilitated by proper training of the nursing and ward personnel, and supervision of this problem by one or two officers in a unit. In this way any change in a patient's condition will be noted early and brought to the attention of the surgeon, and many valuable hours saved. True clostridial myositis should be differentiated from anaerobic cellulitis. In the former, the infection is in the muscles or muscle groups, in the latter it is in the fascial planes, and the muscles are uninvolved. Anaerobic cellulitis responds readily to wide incision, excision of damaged tissues, and penicillin. With the use of penicillin, blood, and perhaps antigas serum, the surgery of true clostridial myositis may be more conservative than formerly. If the infection is limited to one or only a few muscle groups, these alone may be completely excised and a wide fasciotomy performed. No amputation will be performed merely for the control of the infection. If the limb is so badly impaired that it will be of no functional use, or if after excision of the involved muscles the limb would be useless, then amputation is indicated. It should be performed at the lowest level consistent with a healthy useful limb. It need not be completely above the limit of the infection for such infected muscle as may be left can be excised and an extended fasciotomy performed. The patient may then be carried along on penicillin therapy and other adjuncts.

10. *Burns.* Burns will be treated by application of boric ointment gauze and pressure dressings. The use of a snug fitting stockinet over the dressings is recommended. This provides even pressure. Unless the burn is grossly dirty no initial cleansing will be done. Blisters are left undisturbed or aspirated with sterile precautions. When cleansing is necessary, simple non-irritating detergents such as white soap are employed. Loose tags and shreds of tissue are snipped off. No further debridement is carried out. Full aseptic technic in caring for burns, with all personnel masked, is employed. Tannic acid or other escharotics will not be used. In severe burns a secondary anaemia develops, hence, whole blood, as well as plasma will be necessary. The employment of these will be governed by the plasma protein, hematocrit, and hemoglobin levels, as well as by the clinical condition of the patient. Adequate plasma, blood, and fluid replacement is essential, but one must be careful not to drown the patient with an over-enthusiastic program.

11. *The Patient.* From start to finish, from the Aid Man until the final completion, one way or the other, of the case, all those having care of and contact with the wounded, injured, or ill, must constantly bear in mind that he is one of themselves—a human being. Carelessness, neglect, and rough or harsh treatment will never be tolerated. The patient must always be cared for as one would like himself to be treated. Thus, kindness and consideration go hand in hand with therapy.

M. P. RUDOLPH
Colonel, MC
Surgeon

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