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MEDICAL DEPARTMENT
UNITED STATES ARMY
IN WORLD WAR II

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MEDICAL DEPARTMENT, UNITED STATES ARMY

SURGERY IN WORLD WAR II

OPHTHALMOLOGY AND OTOLARYNGOLOGY

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OFFICE OF THE SURGEON GENERAL

DEPARTMENT OF THE ARMY

WASHINGTON, D. C., 1957

QUALITY INSPECTED 1

SURGERY IN WORLD WAR II

Prepared under the direction of

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The Surgeon General, United States Army

The Historical Unit, United States Army Medical Service

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AND
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Foreword

It is implicit as well as explicit in this volume that, in time of war, the specialties of ophthalmology and otolaryngology carry a double burden. Medical officers working in these fields must treat large numbers of patients with complaints referable to the eyes, ears, nose, and throat exactly as they would in civilian practice. They must prescribe glasses, for instance, and then see to it that they are provided and fitted. They must treat upper-respiratory infections. They must, at the same time, treat combat-incurred injuries. These injuries may not be lethal in themselves—generally speaking, they seldom are—but their end results may influence the soldier's whole future life.

In both ophthalmology and otolaryngology in World War II, the problems of peacetime and wartime sometimes overlapped. A peacetime, chiefly industrial, problem, for instance, is the management of intraocular foreign bodies. In wartime, the management of these injuries is a far heavier burden quantitatively. It is also a far heavier burden qualitatively, because of the destructive effect of wounding agents. Otitis externa is a frequent peacetime problem in many parts of the United States. In World War II, it was a major problem in certain areas in the Tropics. Not many patients suffering from it required hospitalization, it is true, but there was, nonetheless, an enormous loss of duty days from this cause. Army records show that during the war approximately 45,000 patients with otitis externa were admitted to medical-treatment facilities on an excused-from-duty basis and that each of these patients lost, on the average, approximately 11 days from duty. Obviously, this particular condition occupied a large part of the time of medical officers assigned to outpatient dispensaries. The upper-respiratory infections which form a significant part of the office practice of an otolaryngologist in peacetime also increased both quantitatively and qualitatively in certain areas in wartime. This was partly because of special climatic conditions, partly because of the conditions under which soldiers necessarily live, and partly because these infections, as a result of the exigencies of warfare, were often neglected at times when they might have been aborted or readily controlled.

One of the interesting features of this volume is the story of the development of new techniques. An instance is the management of selected cases of psychogenic deafness by narcosynthesis, which marked a distinct advance in the treatment of these cases. Another is the development of acrylic eyes, which is an excellent illustration of the combined cooperation and operation of the Medical and Dental Corps. These eyes had numerous advantages over the glass eyes formerly used. Because they could be fitted individually, they looked far more natural, and they were also far more practical because the factor of breakage was eliminated.

The eye centers set up in overseas theaters, which were staffed with specially trained personnel and equipped with special apparatus and instruments, provided outstanding care, with economy of personnel and equipment, and were responsible for the conservation of many eyes which, in the absence of such highly specialized management, might well have been lost.

An outstanding accomplishment in World War II was the extensive and excellent programs of rehabilitation for blinded and deafened casualties. The program for the blinded set up in World War I and continued into peacetime was both extensive and excellent, as is pointed out in this volume. The program for rehabilitation of the deafened in World War I was less extensive and considerably less satisfactory. In World War II, both programs were reinstituted and were expanded and broadened. The program for the hard of hearing has been carried over to the peacetime Army, in which loss of hearing is a continuing problem.

The objective of both of these programs was the readjustment of the casualty to a useful life, by teaching him to make the fullest use of his residual sight or hearing, if any existed, and, if it did not, by teaching him to become independent without the use of these special senses. The programs were set up with courage and imagination, and the results were inspiring. It is reassuring to know that the humanity which underlay them also underlay the treatment of all wartime casualties among United States troops.

S. B. HAYS,
Major General,
The Surgeon General.

Preface to Ophthalmology

This section on ophthalmology in the history of the Army Medical Department in World War II is based on the work and experience of the chiefs of the Ophthalmology Branch in the Surgeon General's Office, the overseas consultants, and medical officers concerned with problems related to the eye. It is a record of administrative phases and the clinical aspects of ophthalmology, as reflected in the policies and practices concerned with both the specialty and its associated activities, such as the optical and artificial eye programs and, most significantly, the program for the rehabilitation of blinded casualties. Some of the clinical procedures described may seem, a decade later, outmoded and archaic, since newer methods have been developed in the progress of ophthalmology; but the administrative experiences may serve as a basis for the conservation of time and energy in the event of another conflict.

The work of the three chiefs of the Ophthalmology Branch was made a great deal less burdensome and even pleasant because of the cooperation and helpfulness of the chief, Surgical Consultants Division, Brig. Gen. Fred W. Rankin, MC, and his deputies, Col. B. Noland Carter, MC, and later Col. Michael E. DeBakey, MC. Their respective sense of equanimity made the administration of the ophthalmic problems considerably lighter.

The optical program, which was under the Supply Service of the Surgeon General's Office, was conducted in frictionless cooperation with the Ophthalmology Branch. A large share of the credit for its effective operation is due to the able administration of Lt. Col. Walter Potter, SnC, and Mr. Stanley Rybak. The administration and supply details of the artificial-eye program were most capably handled by Mr. Rybak.

That blinded casualties would become a major problem was apparently overlooked in the early stages of the war. Not until casualties began to arrive from overseas was it realized that, except for definitive treatment, little provision had been made to prepare the newly blinded soldier to adjust to his new way of life. Lt. Col. James N. Greear, Jr., MC, then chief of the eye section at Valley Forge General Hospital, was certainly the guiding light in initiating what soon became an outstanding blind program. It was through his efforts that the first Army program was inaugurated at Valley Forge. This work was later extended to Dibble General Hospital on the west coast under the splendid leadership of Lt. Col. Norman L. Cutler, MC, and to the Old Farms Convalescent Hospital (Sp), Avon, Conn., under the command of Col. Frederic H. Thorne, MC, an outstanding Army ophthalmologist. The Army rehabilitation program for the blinded could, however, have been a failure without the guidance and efforts of such men as Alan Blackburn, director of training at

Old Farms; Richard Hoover; Paul Conlan; Warren Bledsoe; Russell Williams; and Raymond Frey. Capt. Linus Sheehan, MC, of Valley Forge, also did outstanding work.

In the preparation of the history of ophthalmology in World War II, inclusion of certain phases was made possible by the use of published articles. Sincerest thanks are due to the officers, now civilian doctors, who gave their time and effort to these special articles.

M. Elliott Randolph, M. D.

Preface to Otolaryngology

War otolaryngology has many phases. It is the sum total of the specialty experience of medical officers who gave the service and of the soldiers who received it. In a worldwide encounter, such as World War II, many important incidents and events were either not recorded or were lost in the mass of administrative procedures designed to collect the data for the medical history.

Physicians are seldom trained as historians, and the information that can be of assistance to future generations is not always easy to select. In this history, an attempt has been made to put down the main events which seem to be of value, but due apology is made for any serious omissions, either of events during the conflict or of the name of those whose contribution well deserved to be included.

In what follows are general statements of policy and specific details of important phases of combat otolaryngology. There were so many well-qualified specialists who served that it has been difficult to select all of the contributions which were made. The day-to-day care of the fighting armies required most of the specialists' professional time, and this was cheerfully and continuously available, both at home and abroad. Assignment of medical officers to strategic posts, arranging for regional consultation, and association with colleagues in the countries through which the armies passed was a constant mission of the administrative chiefs.

The authors of the various chapters were chosen because of their outstanding qualifications and contributions. They, as well as many others, were constantly alert to the possibilities of gaining extra knowledge from their experiences. They were previously, and they continue to be, leaders in otolaryngology in civilian life.

For all of us who returned to the country we defended, there will always be a glow of satisfaction and an enrichment of life gained from our Army service.

In the compilation of this history, special appreciation is expressed to The Surgeon General and his staff for their tremendous help with the mass of detail work.

NORTON CANFIELD, M. D.

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Part I

OPHTHALMOLOGY

M. Elliott Randolph, M. D., Editor



Fitting of artificial eye.

CHAPTER I

Administrative Aspects of Ophthalmology in Zone of Interior

M. Elliott Randolph, M. D.

HISTORICAL NOTE [1]

Classification and Assignment of Personnel in World War I

The Section of Ophthalmology in the Surgeon General's Office in World War I was an outgrowth of activities which began before the entrance of the United States into the war. In 1916, the Council of National Defense had established a General Medical Board under which various subcommittees, including a Subcommittee of Ophthalmology, were organized as part of a Division of Surgical Specialties. The first work of this subcommittee, before the United States entered the war, was to circularize the ophthalmologists of the country, in order to identify the physicians willing to assume the obligations of the specialty if and when the military need arose and to secure the record of their training and experience. A second objective of the subcommittee was to identify the physicians who would be willing to undertake special training to fit themselves to assume these obligations.

This subcommittee, together with the subcommittees concerned with the specialties of otolaryngology, brain surgery, oral surgery, and plastic surgery, continued to function after the United States entered the war, while a plan to establish a Division of Head Surgery, to embrace all these specialties, was being formulated in the Surgeon General's Office. The subcommittee ceased to function 29 September 1917, when the new division began to function in the Surgeon General's Office. This Division of Head Surgery continued to function under that name until 30 November 1918; when the Medical Department was reorganized as of that date, the Division of Head Surgery became the Section of Head Surgery, Division of Surgery, and the Section of Ophthalmology, which had functioned under the Division of Head Surgery, became the Subsection of Ophthalmology.

With the entrance of the United States into World War I, the first assistance rendered by the Subcommittee of Ophthalmology to the Surgeon Gen-

[1] The Medical Department of the United States Army in the World War. Washington: Government Printing Office, 1923, vol. I, pp. 437–453.

eral's Office was the utilization of the data concerning ophthalmologists which had previously been collected and classified. On the basis of these data, a set of index cards was prepared for the ophthalmologists assigned to duty in various hospitals or available for such duty. These cards were systematically reviewed, and the initial ratings were altered as reports concerning the officers were received from commanding officers and chiefs of section in military hospitals in the United States and overseas, as well as from inspecting officers from the Surgeon General's Office. In August 1918, a new card index was prepared containing all of this information and also containing, as they became available, reports of work done by officers in the School of Ophthalmology which was opened in the fall of 1918 at Fort Oglethorpe, Ga.

Whenever an overseas assignment in ophthalmology was made, a transcript of all the information on the officer's card was forwarded to the senior consultant in ophthalmology, American Expeditionary Forces, who could thus use the abilities and experience of the officer to the greatest advantage.

It should be emphasized that, although the work just described seems, on the surface, to be little more than clerical, actually, it was of the greatest importance. In 1917, when the United States entered the war, the American Board of Ophthalmology had not yet been incorporated, and no other certifying body was functioning. Initial data concerning an ophthalmologic officer's training and ability therefore rested largely on his personal statements, which did not always prove accurate in the light of the analysis of his work in the Army. On the whole, however, the index originally begun by the Subcommittee of Ophthalmology of the General Medical Board, Council of National Defense, provided reasonably accurate information concerning military ophthalmologists and permitted their assignment on the basis of military requirements and their personal qualifications. Officers found unsuited for the special duties of ophthalmologic practice were released for reassignment.

Between the entrance of the United States into World War I, in April 1917, and 1 January 1919, the Section of Ophthalmology in the Surgeon General's Office was responsible for the assignment of 612 ophthalmologists; 493 assignments were made to base, port, post, and general hospitals in the United States and 276 to overseas installations (the figures are overlapping). During the course of the war, 368 officers were sent to medical officers' training camps, and 360 transfers were made. On 31 December 1919, 150 ophthalmologists were still on overseas duty.

A catalog was also kept in the Surgeon General's Office of opticians who had offered their services in that capacity. Since no provision had been made for commissioning opticians, they could not be inducted into the Army as specialists. Their names and the data concerning their training and experience were, however, properly classified, and the information proved extremely useful later in the war, when optical units were formed and were sent overseas (p. 28).

Hospitals for Head and Eye Injuries

In August 1917, a special hospital for head injuries was authorized for overseas service. Subcommittees of the Council of National Defense representing the various specialties classified under head surgery formed smaller subcommittees on personnel, equipment, hospital construction, and other details, to work with the Supply Division, the Division of Laboratories, the American Red Cross, and other appropriate sections and agencies to implement the authorization. Special Hospital No. 115, for head cases, was mobilized at Cape May, N. J., and sailed for France 14 August 1918. It was set up at Vichy, but it was not until shortly before the armistice that it began to be utilized for the special purposes for which it had been formed.

In the United States, a similar special hospital for head injuries (General Hospital No. 11) was established at Cape May, N. J., with 750 beds. In other general hospitals, subsections of ophthalmology operated under the sections of surgery.

Before casualties began to be returned from overseas, six hospitals in the United States were selected as eye centers, and another was designated for the care of blinded casualties. These hospitals were all staffed and equipped for these special missions. Later, as the number of casualties increased, additional auxiliary eye centers were designated. As the wounded men reached the United States, their names were sent to the Surgeon General's Office, and assignments were made to special hospitals on the basis of individual medical and surgical requirements.

Training

Soon after the Section of Ophthalmology had been established in the Surgeon General's Office, a course of lectures on ophthalmologic practice was prepared for use in medical officers' training camps and at base hospitals. Results were not impressive, though the lectures proved of value in several hospitals in which they were used intensively.

The most notable advance in training during the war was the establishment, in August 1918, of the School of Ophthalmology at Fort Oglethorpe, Ga. This school functioned until the end of 1918. The course of instruction was designed to provide review and postgraduate work for experienced ophthalmologists, special training in military ophthalmology, and basic training in ophthalmology for men who were interested in the speciality and who by examination proved that their current knowledge of it was sufficient to warrant additional training. Examinations were held at the end of the course, and only officers who had done acceptable work were added to the specialty register in the Surgeon General's Office.

Hospital Inspections

Ophthalmologic officers from the Section of Head Surgery in the Surgeon General's Office visited the eye services in all Army hospitals in the Zone

of Interior at least once, and sometimes twice, between September 1917 and July 1918. Deficiencies in personnel and equipment were thus ascertained, and recommendations for changes were soundly based. The majority of these recommendations were acted upon.

On an inspection trip overseas, which lasted from November 1917 to February 1918, an inspecting officer visited all but three of the American base hospitals then operating in France; a French hospital sector from the base to the front; British base hospital areas; and, in England, several general hospitals, a plastic-surgery center, and St. Dunstan's. A complete report of these observations was submitted to the Surgeon General and to the chief surgeon, American Expeditionary Forces. The report included the following recommendations:

1. That all hospitals be equipped with standard ophthalmologic equipment, as planned in the Surgeon General's Office.

2. That separate wards be maintained for ophthalmologic patients.

3. That eye centers be established in each hospital area to care for major eye injuries.

4. That competent ophthalmologic surgeons be assigned to hospitals to be erected in advanced areas.

5. That optical units be organized in the various zones, with a central optical shop for the supply of lenses.

6. That a consultant in ophthalmology be appointed to the chief surgeon, American Expeditionary Forces.

The majority of these recommendations were carried out.

Consultation Service in Zone of Interior Hospitals

The need for consultants in ophthalmology in the United States became acute as casualties with eye injuries arrived in increasingly greater numbers. The consultation service was therefore expanded, and all eye centers, with the exception of Letterman General Hospital in California, were systematically visited and were afforded consultation as needed and requested.

Other Activities

Other activities of the Section of Ophthalmology in the Surgeon General's Office included the supervision of ocular testing in the Aviation Section of the Signal Corps; the supervision of examinations of recruits whose visual qualifications were doubtful; the prescription and provision of spectacles (p. 28); consultation with other sections concerning visual standards; recording of ophthalmologic disabilities on demobilization; revision of diagnoses for the code book; classification of ophthalmologic examinations; revision of history forms; and supervision of supplies and equipment. An important phase of the work of the Section of Ophthalmology was the care of blinded casualties (p. 147).

Ophthalmology Between the World Wars

After World War I had ended, the Division of Surgery, including the Section of Head Surgery, functioned as a separate division in the Surgeon General's Office until 9 September 1919. Then, in the course of postwar contraction, this division functioned under the Section of Surgery of the Hospital Division. During 1921, the activities of this division were reduced almost to peacetime requirements. The general policy, which continued almost until the outbreak of World War II, was one of decentralization, with less supervision by the Surgeon General's Office and with greater responsibility concerning the quality and character of professional work delegated to commanding officers of Army medical establishments operating on a peacetime basis.

During the interim between the wars, practical training was first provided in the Walter Reed General Hospital clinic for medical officers designated to receive special instruction in ophthalmology. On 1 September 1923, when the Army Medical Center was established at Walter Reed General Hospital for the furtherance of the educational system of the Medical Department of the Army, a department of ophthalmology was included in it.

OPHTHALMOLOGY BRANCH, OFFICE OF THE SURGEON GENERAL [2]

The Ophthalmology Branch of the Surgical Consultants Division, Office of the Surgeon General, was not activated until 15 April 1944. Before that time, all matters pertaining to the specialty had been handled by the chief of Surgical Consultants or some other surgeon designated by him in the division.

The functions of the branch were to (1) establish policies and procedures in general ophthalmology and care of the blind in the Army, (2) advise on assignments of qualified specialists in these fields, (3) correlate information and afford consultation and advice pertaining to ophthalmology and care and management of the blind, and (4) maintain liaison with the Navy Department, Veterans' Administration, Federal Security Agency, and civilian ophthalmologic groups.

Maj. (later Lt. Col.) M. Elliott Randolph, MC, served as chief of the Ophthalmology Branch from its activation until 22 February 1945 and again from 8 December 1945 until 1 April 1946. Col. Derrick T. Vail, MC, served in this capacity from 22 February to 28 July 1945, and Maj. (later Lt. Col.) Trygve Gundersen, MC, served from 28 July to 8 December 1945.

Civilian consultants.—Three civilian consultants to The Surgeon General were appointed 13 March 1943; namely, Dr. Harry S. Gradle of Chicago, Dr. Alan C. Woods of Baltimore, and Dr. Frederick C. Cordes of San Francisco.

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[2] Unless otherwise indicated, material in this chapter is based on reports submitted to the chief, Ophthalmology Branch, Surgical Consultants Division, Office of the Surgeon General, by the chiefs of service at the Crile, Cushing, Dibble, Northington, Newton D. Baker, O'Reilly, Valley Forge, Wakeman, and William Beaumont General Hospitals.

Although their chief concern was the treatment of blinded casualties, they were available for consultation on all other subjects, and they frequently had informal conferences with the consultant in ophthalmology. Dr. A. D. Ruedemann of Cleveland acted as civilian consultant at the Crile General Hospital Eye Center. He was particularly helpful in training in his private office the technicians responsible for certain phases of the ophthalmologic program at that hospital.

Classification and Assignment of Personnel

Since the results of ophthalmic surgery depend upon the training and experience of the personnel responsible for it more than upon any other single factor, one of the first activities of the chief of the Ophthalmology Branch, Office of the Surgeon General, was to survey the ophthalmologic personnel in each service command. The following letter was sent out to the surgical consultant in each service command 2 September 1944:

> The purpose of this letter is to discuss informally with you the question of competent ophthalmologists in general and regional hospitals throughout your service command.
>
> Directives shortly to be published will clarify the disposition of all cases originating overseas and in this country * * *. Specifically, as far as eye cases are concerned, all cases of intraocular foreign bodies, neoplasms, or cases requiring plastic surgery will be sent to designated Ophthalmic Plastic Centers. All cases which do not fall into the above three categories will be taken care of in regional hospitals or, as with overseas patients, in the general hospital nearest the patient's home. It is, therefore, highly important that a competent and well-trained ophthalmologist should be at each of these general and regional hospitals in your service command. Each clinic should be staffed and equipped to handle the types of ophthalmological cases encountered in civilian life, such as detached retina and enucleation, glaucoma, cataract, uveitis, etc.

Each of these letters continued with a review of the qualifications and competency of the ophthalmologists assigned to all installations in the particular service command and ended with suggestions for possible changes and reassignments.

These suggestions were for the most part carried out. The additional suggestion that the consultant of each service command designate an ophthalmologist in the command to serve as a part-time consultant, in order to make a survey of ophthalmologic activities within the command, was accepted only in the Ninth Service Command. The results of his efforts clearly indicated the usefulness of part-time consultants in ophthalmology as well as the advisability of periodic surveys.

Classification of ophthalmologists.—The initial classification of medical officers in World War II was made from basic information entered on WD AGO Form 178–2, Classification Questionnaire of Medical Department Reserve Officers, or WD AGO Form 66–3, Classification Questionnaire of Medical Department Officers. These forms contained the officer's own statement concerning his training and experience, and this information, in the absence of more specific evidence, was used as the basis of his assignment until his per-

formance could be demonstrated. The classification symbol, MOS, for ophthalmologists was 3125, and the letters A, B, C, and D indicated training and other qualifications as follows:

A–3125. This group consisted of ophthalmologists with a civilian or military background of outstanding ability and of such unequivocal prominence in the specialty as to make them authorities in their field. They had usually made important contributions to scientific research, to the development of ophthalmology, and to the ophthalmologic literature.

B–3125. This group consisted of ophthalmologists with superior training and experience. Physicians certified by the American Board of Ophthalmology were automatically placed in this category. Their training in the specialty had been sufficiently long and was of such quality as to insure the optimum in professional knowledge and technique, as judged by standards normally employed in recognized teaching centers.

C–3125. This group consisted of young ophthalmologists who had recently completed the intensive training required for specialization but who had not yet acquired the mature judgment of specialists with longer experience. The group also included older physicians who had had less formal training in ophthalmology but who had had extensive experience in the specialty in environments normally associated with high professional standards.

D–3125. This group included ophthalmologists with sufficient training or experience, or both, to justify classification in a specialty group. Necessarily, this was a broad group made up of officers with various degrees of professional competence. For example, an officer who had recently completed a 1-year residency or fellowship in ophthalmology in a recognized teaching center would be placed in this group, and also included would be a mature individual without formal training who had not strictly limited his practice to this special field but who had devoted a large proportion of his time to it. In certain selected instances, officers who had completed internships limited to this specialty in institutions in which the standards were recognized as superior might be included.

Reevaluation was continuously carried out. Transfer to a higher classification was dependent on the demonstration of qualifying professional ability, supported by the professional judgment of observers who were, necessarily, experts in the field. As a rule, reevaluation was never considered within a period of less than 3 months unless, as occasionally happened, the initial classification had been grossly inadequate. Certification by the American Board of Ophthalmology automatically advanced the officer to a B classification. Occasionally, an officer without specialty rating was elevated to a D classification upon demonstration of competence in the specialty greater than would be expected of a medical officer not classified as a specialist.

Survey of assignments.—A survey of the service commands carried out by the chief of the Ophthalmology Branch in September 1944 showed that in 98 percent of all installations in the Zone of Interior the chief of the ophthalmologic

section had a classification of B–3125. As of 20 June 1945, according to the Personnel Division, Classification Branch, Office of the Surgeon General,[3] 647 ophthalmologists of all grades were on duty with medical installations in the Zone of Interior and overseas, and 17 others were attached to other organizations—14 to fixed units at ports of embarkation, 2 to the office of the Chief of Engineers, and 1 to the office of the Chief of Chemical Warfare. Of the 647 ophthalmologists, 6 had the classification of A–3125, 384 of B–3125, 157 of C–3125, and 100 of D–3125. Distribution and classification of the 203 ophthalmologists assigned to the Zone of Interior as of 20 June 1945 are shown in table 1.

TABLE 1.—*Classification and assignment of ophthalmologists in Zone of Interior, 20 June 1945*

Service-command assignment	A–3125	B–3125	C–3125	D–3125	Total
First		8	1	1	10
Second		11	5	3	19
Third	1	10	7	5	23
Fourth		23	8	6	37
Fifth	1	11	3	4	19
Sixth		7	2		9
Seventh		13	3	3	19
Eighth		22	8	2	32
Ninth		22	4	5	31
Military District of Washington	1	3			4
Total	3	130	41	29	203

Ophthalmologists were in short supply throughout the war, the shortages being particularly evident in the special ophthalmic-plastic centers. The ideal, 1 ophthalmologist for each 50 hospital patients, was almost never realized, although constant efforts were made to achieve it.

Inspection Trips

Each of the special eye centers was visited by the chief of the Ophthalmology Branch at least once during the course of the war, and several were visited two or more times. The center at Valley Forge General Hospital, because of its close proximity to Washington, was sometimes visited twice in a month, if special needs arose. In the course of these visits, the work of the ophthalmologists was studied, the management of patients was observed, policies of professional care and adherence to Army directives were inquired into, equipment was examined, and all other matters were investigated. This, in the aggregate, made for a smooth and efficient organization. If the number

[3] Memorandum for record, Maj. M. E. Randolph, 21 Feb. 1946, subject: Classification and Assignment.

of patients at an installation was small, each was examined. If the number was too large for this plan to be practical, an adequate cross section was investigated. The superior qualifications of the ophthalmologists in charge of the eye centers eliminated the need for a great deal of personal professional supervision.

In addition to visits to the eye centers, visits were also made to the ophthalmologic sections of other hospitals. These inspections followed the same general plan as that described for the eye centers. Some services were considerably less active than others, but, in general, it was believed that at all installations equipment was adequate, clinical facilities good, the staff competent, and the quality of the work on a high level.

Liaison with installations not visited was maintained through the service-command consultants in surgery who referred problems to the Ophthalmology Branch, Office of the Surgeon General, as they arose.

Liaison Activities

Liaison with ophthalmologists in overseas theaters was, for the most part, maintained informally, through correspondence. Shortly after the Ophthalmology Branch was activated in the Office of the Surgeon General, it was requested that theaters include, in their Essential Technical Medical Data reports, specific information concerning ophthalmologic personnel, assignment of personnel, the care of battle casualties, and problems of supply.

Every possible attempt was made to expedite supplies required for overseas theaters. Close liaison was maintained with the Supply Division and the Optical Branch of the Supply Service. In fact, the relationship between the section of the Supply Service concerned with ophthalmologic supplies and the Ophthalmology Branch proved to be so close that eventually their offices were maintained in the same room.

The chief of the Ophthalmology Branch represented the Technical Information Division of the Office of the Surgeon General at the monthly meetings of the Army-Navy Vision Committee of the Office of Scientific Research and Development. For the most part, these meetings were concerned with the problems of sungoggles and night vision. The chief of the Ophthalmology Branch also served as liaison member to the committee on sensory devices of the Office of Scientific Research and Development. In May 1945, as a representative of The Surgeon General, he attended an important meeting on industrial ophthalmology held in New York. Several meetings were held with representatives of the Ordnance Department and the Corps of Engineers concerning armored protective devices for the eyes.[4]

The chief of the Ophthalmology Branch (Col. D. T. Vail, MC) participated in the 1945 examinations of the American Board of Ophthalmology. One of

[4] A design submitted by one of the chiefs of the Ophthalmology Branch (Col. D. T. Vail, MC) was favorably received and would probably have been standardized had the war continued. [Editor's note.]

the objectives of his participation was to observe the performance of candidates for the Army.

Preparation of Manual of Instructions for Testing Visual Acuity

One of the important activities of the chief, Ophthalmology Branch, Office of the Surgeon General, was to serve as chairman of the Subcommittee on Procedures and Standards for Visual Examinations of the Army-Navy Office of Scientific Research and Development Vision Committee. This subcommittee was originated to prepare a manual of instructions for testing visual acuity.

When the work was undertaken, specifications for rejection of candidates for Army service, although they had undergone considerable change between 1940 and 1944, were quite clear cut. Diseases and conditions which made the candidate undesirable for Army purposes were specifically stated. Specifications for testing, however, were not clear cut.

The specified routine included only inspection with lids everted for evidence of disease and muscular and other defects, and testing of visual acuity. Additional examinations, including refraction, were to be made only if defects were evident in the routine examination. The routine test for visual acuity was to be given at a 20-foot distance from the test types, with the applicant's back to the window, each eye being tested separately while the other was completely occluded; glasses were not to be worn. Vision of less than 20/40 in either eye required the additional examinations just mentioned. The correcting formula was recorded. Special instructions were given for testing suspected malingerers, and the examiner was warned to bear in mind that a serious nerve lesion might be responsible for such phenomena as diplopia. Exact methods of testing, strict environmental circumstances, and similar matters were not discussed.

The purpose of the manual of instructions for testing visual acuity, which represented the first attempt at standardization in the services, was to establish uniformity of physical equipment, lighting, and other conditions for the conduct of visual-acuity tests. Even such items as the occluder used to shield the eye not being tested were described in complete detail. On 10 July 1945, the Subcommittee on Procedures and Standards for Visual Examinations recommended the manual for use by the Armed Forces, and a copy was submitted to the Physical Standards Division of the Office of the Surgeon General. It was the opinion of the members of the subcommittee that the adoption of this manual would mean that, in the future, the Army and Navy would employ comparable visual-acuity tests and that examinations carried out in one part of the country would, for the first time, be precisely similar to those carried out elsewhere in the country.

SPECIALIZED CENTERS

When the Ophthalmology Branch was activated in the Office of the Surgeon General in April 1944, four specialized ophthalmic-plastic centers were

already in operation at the following general hospitals: Letterman, San Francisco, Calif., (Dibble, Menlo Park, Calif., later replaced Letterman as the ophthalmic-plastic center on the west coast); Valley Forge, Phoenixville, Pa.; O'Reilly, Springfield, Mo.; Bushnell, Brigham City, Utah; and William Beaumont, El Paso, Tex. Additional ophthalmic-plastic centers were later activated at other general hospitals (table 2). Although these specialized facilities were established for the most part without a prior investigation of the qualifications of the incumbent ophthalmologic personnel, all but a few of the staff members subsequently proved to be well qualified for their enlarged responsibilities.

TABLE 2.—*Specialized eye centers in general hospitals in Zone of Interior*

Center	Date of designation	Beds authorized		Total admissions
		Initial	Maximum	
O'Reilly, Springfield, Mo	June 1943	300	600	2,935
Valley Forge, Phoenixville, Pa	October 1943	[1] 500	850	3,653
William Beaumont, El Paso, Tex	November 1943	variable	300	2,459
Baker, Martinsburg, W. Va	January 1944	[2] 50	200	997
Dibble, Menlo Park, Calif	June 1944	300	300	2,712
Wakeman, Camp Atterbury, Ind	do	300	300	776
Northington, Tuscaloosa, Ala	October 1944	250	300	1,399
Cushing, Framingham, Mass	do	47	163	783
Crile, Cleveland, Ohio	March 1945	250	250	553

[1] Including beds for blinded casualties and casualties requiring plastic surgery.
[2] Including beds for otorhinolaryngology.

Population

Army Service Forces Circular No. 365, issued 6 November 1944, specified the types of patients to be admitted to the specialized centers, as follows:

2. All patients whether from overseas or in this country who have intraocular foreign bodies, orbital or intraocular neoplasms, or those requiring plastic surgery of the lids and orbit will be transferred to a named general hospital designated for plastic and ophthalmic surgery.

3. All patients returning from overseas with conditions other than those referred to above, such as enucleation, retinal detachment, cataract, glaucoma, intraocular and extraocular inflammation, and the like will be transferred to a named general hospital, but patients with similar conditions in the zone of interior will be transferred to the nearest regional station hospital. Minor eye conditions not requiring specialized care such as mild acute conjunctivitis, hordeolum, chalazion, and the like are not included in this category and need not be transferred.

Until their activation as specialized eye centers, the ophthalmologic sections of Valley Forge, O'Reilly, Beaumont, Baker, Dibble, Wakeman, Northington, Cushing, and Crile General Hospitals had functioned in the same manner as ophthalmologic sections in all other general hospitals, except that, early in

1942, O'Reilly General Hospital had been designated to care for a group of 50 eye casualties from Pearl Harbor. During this period, the source and quantity of the routine work depended upon the location of the installation. William Beaumont General Hospital, for instance, drew its ophthalmologic patients from surrounding posts, including Fort Bliss, Tex., and White Sands Proving Ground, Las Cruces, N. Mex. It also cared for dependents of personnel from these facilities and from Biggs Field. Wakeman General Hospital drew its patients from the Army Specialized Training Unit at the University of Indiana, Atterbury and Freeman Army Air Fields, and from the following sources at Camp Atterbury: Induction and separation centers, reception center for overseas troops, school for enlisted technicians, the 1560th Service Unit, and training units of the 106th Division and the 729th Military Police.

As the war advanced, the number of battle casualties, many of whom were admitted directly to the centers from overseas, grew larger and larger. Increasing numbers required plastic surgery. At the Wakeman center on 15 May 1945, 250 patients were awaiting plastic surgery of the lids or orbit. At the O'Reilly center on 5 September 1945, 428 of the 607 patients in the eye section were battle casualties, and 50 percent of the operations accomplished were undertaken for plastic reconstruction of the lids and sockets. At this center, during 1945, approximately one-fourth of all patients assigned to the eye service required some type of plastic or reconstructive work on the lids and orbits, and two-thirds of all operations performed were plastic procedures. At all the centers, numerous patients had multiple injuries which required successive treatment by various surgical specialists, especially by specialists in neurosurgery and orthopedic surgery.

Personnel

Under an ideal setup, which was achieved in only a few centers, the personnel of the specialized eye center consisted of a chief of service; an assistant chief of service; additional ophthalmologists in the ratio of 1 to each 50 patients; optometrists and opticians; field technicians; wardmasters and enlisted aidmen; supervisory and other nurses; and civilian, secretarial, and other help.

The load in most of the eye centers was heavy. In some, such as the one at Valley Forge General Hospital, 1 ophthalmologist was sometimes responsible for from 100 to 150 patients and for as many as 190 patients if those on furlough were included. After January 1945, nonspecialized medical ward officers were made available to take histories, do routine physical examinations, and supervise records. In some centers, such as the one at O'Reilly General Hospital, a Medical Administrative Corps officer assumed responsibility for requisitioning of supplies, supervision of civilian ward attendants, maintenance of ward discipline, and similar matters. Specialists were thus freed for professional duties, and the desirable doctor-patient relationship was greatly improved, since all disciplinary matters were handled by a nonmedical ward officer.

ADMINISTRATION AND ORGANIZATION OF EYE SERVICES

In most hospitals in the Zone of Interior, the ophthalmologic and otolaryngologic services were conducted as a unit from the administrative standpoint, and that policy remained in effect in some of the eye centers for some time after they had been activated. The plan of joint operation was not always satisfactory in the nonspecialized general hospital services and was definitely disadvantageous when the activation of an eye center within a hospital brought with it additional responsibilities and problems.

When services were operated jointly, the ward officer or other assigned officer handled the wards as a single administrative unit, though ophthalmologic patients were assigned to one ward and otolaryngologic patients to another. When the services were separated, unless a Medical Administrative Corps officer was responsible for ward routine a member of the ophthalmologic staff was responsible for a ward or a group of wards. The assignment necessarily depended on the size of the patient load and the numerical adequacy of specialized personnel.

At Valley Forge General Hospital, where ophthalmologic personnel was always in short supply, each medical officer was responsible for 4 to 6 sections, containing 78 to 140 beds, with a patient load of 80 to 190 patients, including those on furlough. For most efficient work, the optimum number of patients for 1 ophthalmologist had been set at 50 to 60, of whom it was assumed that 15 to 25 would be on furlough at any one time.

At the Wakeman General Hospital Eye Center, the ward in which plastic eye surgery was carried out was originally under the supervison of the chief of plastic surgery, but in December 1945 it was made an integral part of the eye service.

At O'Reilly General Hospital, as soon as a qualified ophthalmic-plastic surgeon became available, the service was divided into three sections, outpatient and consultation, ophthalmologic, and ophthalmoplastic. Diagnosis and therapy were facilitated by this division, particularly when the number of patients increased sharply in proportion to the number of specialized personnel available to handle them.

At William Beaumont General Hospital, where the patient load was almost constantly high and where the specialized ophthalmologic personnel never numbered more than three, the chief of section directed treatment and disposition of all officer patients and, if necessary, routed them through the Retiring Board. A second officer served as chief of the ophthalmologic-surgery service and had charge of patients needing plastic procedures and patients with intraocular foreign bodies, intraocular neoplasms, and retinal detachments. The third officer served as chief of the ophthalmologic clinic. His duties were concerned with the treatment of clinic patients, refractions, and the disposition of enlisted men. Since all three officers were certified by the American Board of Ophthalmology, they all operated.

At some installations, it was believed that better results were obtained when an ophthalmologist was made responsible for the care of individual patients who were assigned exclusively to him; at other installations, it was thought that a cooperative effort gave better results, though only if there was complete freedom of consultation and discussion. Retention of specialized personnel was a continuing problem, the turnover of nurses and enlisted men who had been trained to the point of usefulness being particularly troublesome.

Consultations

Every effort was made to expedite consultations, in order to eliminate unnecessary delays in the disposition of patients. Consultations were usually routed through the message center to the ophthalmologic clinic. In most installations, appointments for ambulatory patients were made for the day following the date of request. In a few hospitals, an early morning hour was automatically reserved for the handling of consultations without prior appointment. Bed patients were seen the day the consultation was requested, unless arrangements to the contrary were made with the ward officer. Emergencies were properly indicated and handled immediately. At some centers, when the influx of patients was heavy, it was necessary for ophthalmologists to work regularly as late as 2100 hours in order to prevent the accumulation of a backlog. All interesting, unusual, and obscure cases were seen by several ophthalmologists, and every effort was made to see that all such cases were also observed by officers whose experience had not been particularly wide. For the same reason, ward officers were, as far as possible, given opportunities to work in the clinic, assist in dressings and examinations, and in general increase their specialized experience.

Staff Conferences and Ward Rounds

Policies concerning staff conferences varied from hospital to hospital. At the Wakeman General Hospital Eye Center, where the load was heavy and there was a constant shortage of specialized personnel, no formal meetings of the ophthalmologic section were held, but attention was called to interesting and unusual cases by notices posted on the bulletin board, and informal discussions were held concerning them.

At the Northington General Hospital Eye Center, detailed ward rounds, with a complete review of each case, were made once weekly and occupied 3½ hours. Inspection rounds, which occupied 1½ hours, were also made once weekly with the chief of the surgical section. At Dibble General Hospital, grand ward rounds were held once weekly, and an informal staff conference was also held once a week for the discussion of administrative matters as well as clinical ophthalmologic problems.

At Valley Forge General Hospital, grand rounds on the ophthalmologic wards were made once weekly with the chief of the eye section or his assistant. Staff conferences were held at least once a week, and frequently more often. Interesting and unusual cases were presented, and special problems were discussed, including the disposition of patients. The staff was large at this hospital, and informal meetings of the chief of the eye section and 2 or 3 staff members were held frequently to settle special problems of diagnosis, treatment, or disposition.

At Wakeman General Hospital, ward walks occupied 2 hours every Saturday morning. During these rounds, every patient was seen, and every unusual case was discussed. The walks were preceded by a general-staff conference, lasting an hour and attended by every medical officer in the hospital. The surgical section was responsible for the presentation one week and the medical section the next.

At Baker General Hospital, no formal ophthalmologic staff conferences were held, but ward rounds were made at 0800 daily except Sunday. The ophthalmologic section was responsible in its turn for the presentations at the general surgical staff conferences.

At the O'Reilly General Hospital Eye Center, three types of conferences were held. On Saturday mornings, the entire medical staff met with a special service or section responsible for the whole program each time. On Sunday mornings, all professional departmental heads met to discuss matters of policy pertaining to the disposition of patients and other matters. These meetings, which were presided over by the chief of clinical services, provided excellent opportunities for individual chiefs of sections and services to adjust possible difficulties. Every Monday afternoon, a purely clinical conference was held, at which the staff of the ophthalmologic section met with the staffs of the plastic, neurosurgical, and neurologic services and frequently with the staffs of the dental and medical services. Clinical problems were discussed, and, as they were available, slides and specimens were shown by the pathologist.

At Beaumont General Hospital, the surgical section held at least one meeting each week, each service in turn making a presentation of clinical material. Administrative and procedural problems were also discussed. The entire staff of the hospital met once weekly, for the presentation of clinical material. A special ophthalmologic conference was also held each week.

Liaison With Other Professional Services

Cooperation between the various services within the eye centers was usually excellent. It was particularly close between the ophthalmologic service and the neurologic, neurosurgical, and radiologic services. In the first years of the war, the ophthalmologic services in the Zone of Interior, in addition to routine work, made many examinations of fundi to assist in the evaluation of medical

and neurologic conditions. Later, neurosurgical patients were referred for complete eye examinations. Radiologists were of particular assistance in the localization of foreign bodies.

Much assistance was provided by Red Cross workers and occupational therapists, who provided occupational activities and entertainment not only for blinded patients but for those temporarily without the use of their eyes, particularly after operation.

Disposition of Patients

When a patient had received the maximum benefit likely to be achieved by treatment at an eye center, his ophthalmologic status was carefully evaluated and recommendations were made concerning the possibility of his being returned to duty, assigned to limited duty, or separated from service. Officers with eye disabilities which precluded their meeting the minimum standards for limited service went before a retiring board on which an ophthalmologist, usually the chief of service, served as medical witness. An officer qualified for limited duty was given the choice of service or retirement. An enlisted man certified for limited duty had no choice but to accept the decision.

Records

Ophthalmologic records (figs. 1 and 2) were, as a rule, complete and fully annotated and were therefore useful in the management of patients who, because of the exigencies of military service, were often treated at different times, by different surgeons, and in different installations, even in the Zone of Interior. In addition, they proved valuable in clinical studies and as a source of clinical and statistical data.

A great deal of effort was devoted to keeping the records accurate and complete. Dictaphones were provided, and stenographic assistance was distributed as equitably as possible between wards and clinics. In many installations, duplicate ward and clinic records were maintained and proved extremely useful in a specialty in which much treatment for ward patients was provided for in the clinic. As always, the exact method by which records were kept was in no way comparable in importance to the maintenance of adequate histories and the desire and effort on the part of the staff to make them complete.

Research

Ophthalmologic research in the Zone of Interior was concentrated at the Wakeman General Hospital Eye Center. By directive of The Surgeon General,[5] the laboratory was activated 1 January 1945, with 2d Lt. A. D. Cooper, SnC, in charge and a technician fifth grade as assistant. Later, a private, first class,

[5] Annual Report, Wakeman General Hospital, fiscal year 1944–45.

OPHTHALMOLOGIC EXAMINATION — DATE

NAME (*Last, First, Middle Initial*)	ARMY SERIAL NO.	GRADE	AGE	WARD

HISTORY

VISION WITHOUT CORRECTION		PRESENT CORRECTION				
		SPHERE	CYLINDER	AXIS	PRISM	VISION
FAR	R. E.					
	L. E.					
NEAR	R. E.					
	L. E.					

PRESCRIBED CORRECTION						RETINOSCOPY
	SPHERE	CYLINDER	AXIS	PRISM	VISION	R. E. L. E.
FAR	R. E.					
	L. E.					
NEAR	R. E.					
	L. E.					

COLOR VISION

TENSION
R. E. MM. L. E. MM.

PUPILLARY REACTION

ASSOCIATED MOVEMENTS

MUSCLE BALANCE

EXTERNAL EXAMINATION

MEDIA AND FUNDUS

DIAGNOSIS

TREATMENT

FRAME SPECIFICATIONS	P. D.	BRIDGE	TEMPLE	EYE SIZE	DECENTER R. E. L. E.	BIFOCAL SEGMENT HEIGHT	BIFOCAL INSET

GAS MASK DATA	GAS MASK SIZE	INSERT SIZE	DECENTER R. E. L. E.

WD AGO Form 8-41
10 January 1945

(This Form supersedes MD Form 8SE-2, 9 June 1942 which will not be used upon receipt of this revision.)

16—68204-1

FIGURE 1.—Chart for ophthalmologic examination.

was added as surgical assistant and a German prisoner of war assigned to work in the animal house.

Three chief problems were assigned for investigation: (1) The development of new methods of treatment for nonmagnetic intraocular foreign bodies; (2) the prevention of symblepharon by use of anticoagulants; and (3) the effect of antiseptics on the regeneration of corneal epithelium.

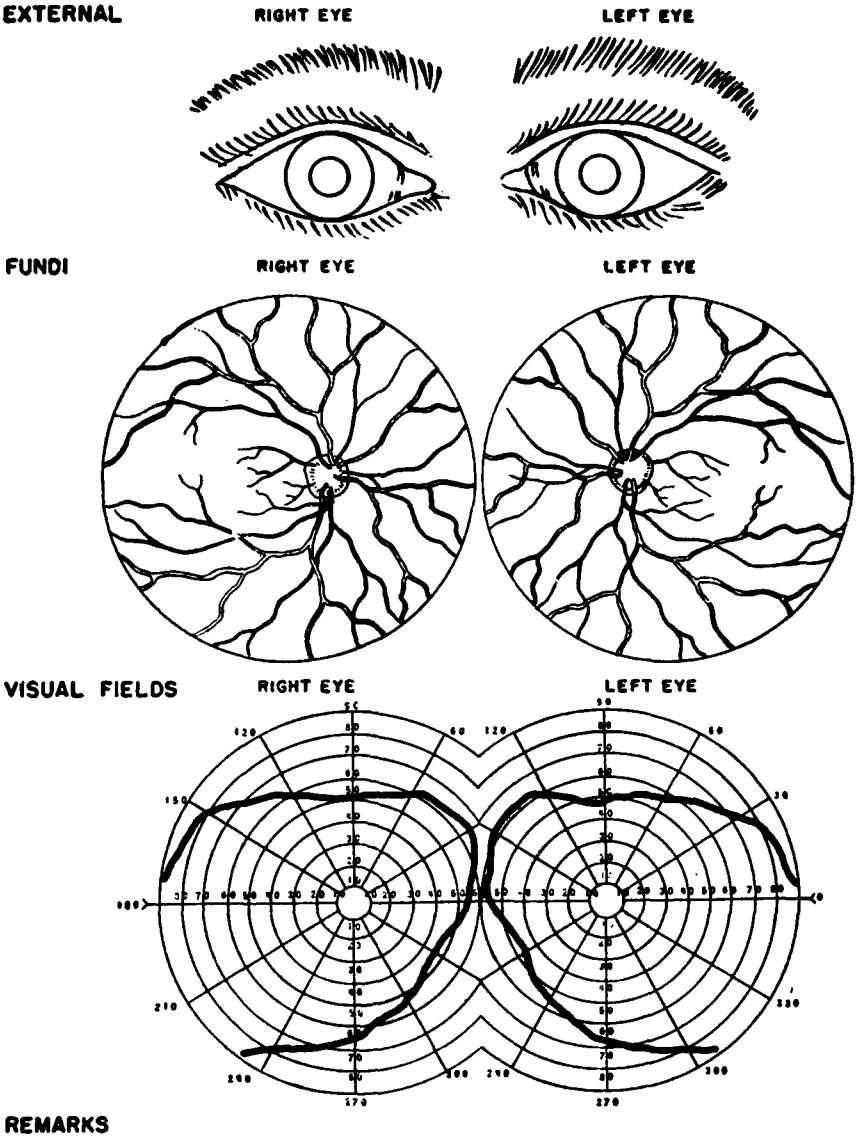


FIGURE 2.—Reverse of figure 1.

FACILITIES [6]

Clinical Space

At most hospitals, facilities for ophthalmologic care consisted essentially of ward space, clinic and office space, and operating rooms (figs. 3, 4, and 5). In the eye centers, the amount of allotted space was usually increased, and, in addition, provision was made for laboratories for the manufacture of plastic eyes (fig. 6). In some installations, facilities other than wards were housed in a building used only for ophthalmologic purposes. In others, as at Crile General Hospital, they were provided in a building shared with the otolaryngologic service. At the O'Reilly General Hospital, the ophthalmologic clinic was originally housed in a 150- by 25-foot medical clinic and laboratory building shared by the otolaryngologic clinic, the hospital laboratory, and the pharmacy. Space was extremely limited, and only one refraction range could be operated. In June 1942, when a large enlisted-technicians school was activated at the hospital to train more than 2,000 students, the number of

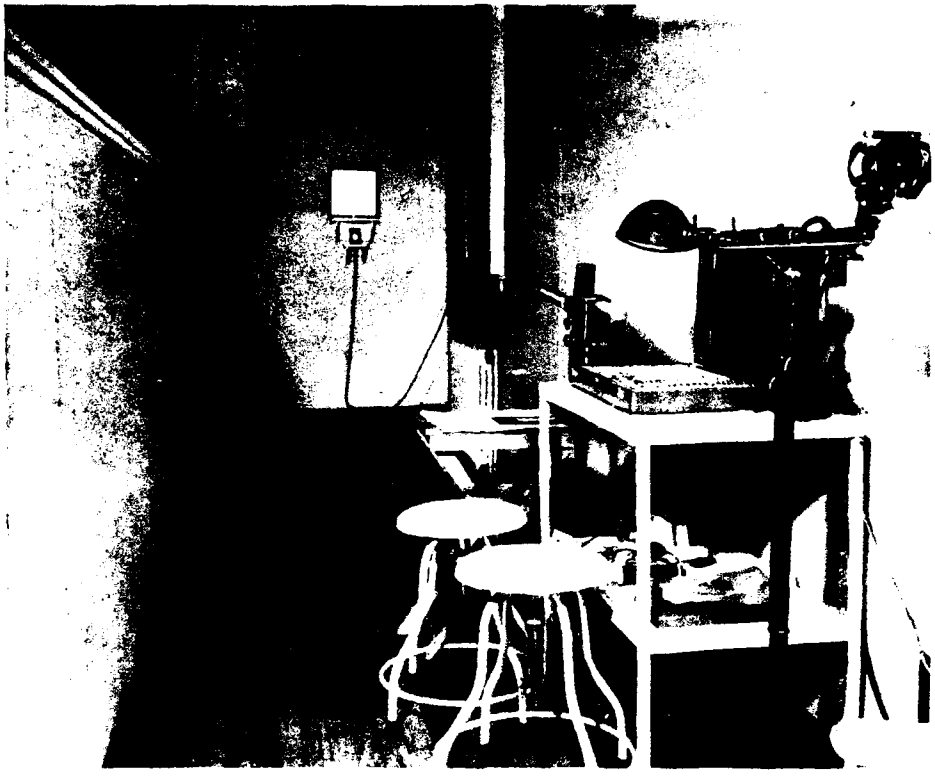


FIGURE 3.—Refraction room in specialized eye center.

[6] In the strict military sense, the term facilities has rather far-reaching implications. It includes such physical considerations as building and shelter of all types, as well as equipment, both generalized and specialized, and even money. It also includes all personnel required to staff the facilities. As a matter of convenience, personnel is discussed under a separate heading in this volume.

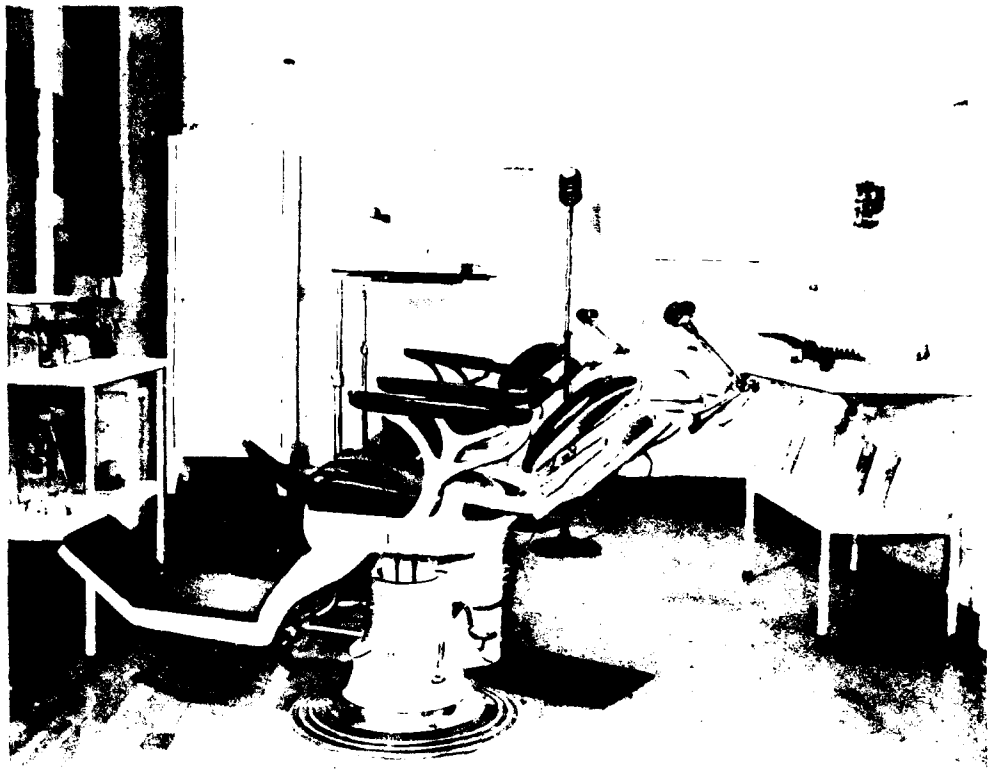


FIGURE 4.—Treatment room in specialized eye center.

refractions required made the available facilities completely inadequate, and a 150- by 34-foot modified standard ward building was converted, which permitted a greatly enlarged eye clinic.

The eye clinic at Beaumont General Hospital at first utilized the facilities of the otolaryngologic service, which occupied a building large enough to house the radiologic department also. In July 1944, when the Station Hospital at Fort Bliss was consolidated with William Beaumont General Hospital, the large building at the former institution which had been used for a combined eye, ear, nose, and throat clinic was transferred to the ophthalmologic service. This building was used only for clinic purposes. All surgical patients were cared for in the main hospital, where additional ward space was made available for the increasing number of casualties from overseas.

Clinic space was usually organized as it would be in a large civilian ophthalmologic service. The refraction room was equipped with two 20-foot lanes, and an additional 10-foot range was sometimes provided in part of the office space. A separate room was usually provided for the study of visual fields, and in some installations a separate room was also provided for perimetry.

Operating-room facilities were sometimes independent, sometimes part of the central operating room, and sometimes shared with the otolaryngologic

service, an arrangement which was regarded as both unsatisfactory and dangerous because of the risk of cross-infection. When the situation could not be altered, the ophthalmologic service used the facilities one day and the otolaryngologic service the next. It was generally agreed that the eye operating room was best maintained as part of the eye clinic rather than as part of the main operating room, because of the highly specialized equipment, such as slit lamps, binocular ophthalmoscopes, and giant magnets, which were used in both operating rooms and clinics and which either could not be moved or might be harmed by constant moving. Minor surgical procedures, such as incision and drainage, irrigations, lipiodol studies, and removal of superficial foreign bodies, were usually done in the treatment room.

Ward space varied in the different centers according to the patient load. At the Crile center, the facilities consisted of a 35-bed ward for general surgical cases, a 34-bed ward for nonsurgical cases, a 35-bed ward for plastic surgical cases, and a 32-bed ward for convalescent patients and patients awaiting artificial eyes. Officers and WAC's were treated on separate wards. A well-equipped treatment room near the plastic-surgery ward was convenient for dressings and other treatments. Every bed in the eye center was equipped with radio earphones and a station selector dial, so that patients who could not use



FIGURE 5.—Eye operating room in specialized center, showing giant magnet counterbalanced through pulley in ceiling.



FIGURE 6. Eye prosthetic laboratory.

their eyes were provided with entertainment. At Dibble General Hospital, at the time of the peak census in July 1945, the ward space available consisted of 6 standard wards containing from 52 to 69 beds each and 4 convalescent wards containing 42 beds each.

Facilities for the plastic-eye laboratory varied in different centers. At the Crile center, the space allotted eventually consisted of about 600 square feet, divided into a reception room and office, laboratories, and four cubicles. The cubicles were assigned, respectively, to the artist who painted the disks; to the technician who made the wax impressions; to the technician who did the veining, color modifications, and similar work; and to the technician who did the fitting and adjusting. Work requiring natural-type light was done in cubicles equipped with large fluorescent lights. Special attention was paid to lighting in all laboratories to permit accurate color matching regardless of external conditions.

At the Wakeman eye center, which was designated for research work, a laboratory 250 feet square was equipped with a fume closet and other usual laboratory utilities and equipment. A special fund was allotted to provide nonstandard equipment, including a Beckman spectrophotometer, a polarograph, and research grade chemicals. Two rooms in the animal house were large enough to house an animal colony of about 75 albino rabbits.

Library Facilities

As might have been expected, library facilities in ophthalmology were not uniform in the various hospitals, since most of the books and journals had not been selected by specialists in this field. Not all hospital libraries were equally supplied, and in many instances ophthalmologists sent for and used their own texts. Books could be procured from nearby local medical libraries and from the Army Medical Library, Washington, D. C., but some delay occurred, particularly when the facilities of the Army Medical Library had to be used by hospitals distant from Washington. Some hospitals had current specialty journals and bound volumes for several recent years, but others did not, and at those installations individual ophthalmologists provided their private journals.

Equipment

Generally speaking, the equipment for ophthalmologic sections in general and regional hospitals in the United States was eventually quite satisfactory, though originally the standard eye instruments were not widely popular. Particular complaints were raised concerning forceps, specula, discission knives, capsule forceps, and suture materials. While these items were in process of improvement and standardization, requisitions for nonstandard items were usually approved. Thereafter, it was thought that the standard instruments were satisfactory in both quality and supply, and requests for nonstandard items were not generally approved.

An entirely different attitude was taken toward equipment in the special centers, in which ophthalmologists were permitted and encouraged to use nonstandard instruments of their own choosing whenever it was thought that their work would thereby be improved. It was the general opinion of the ophthalmologists working in these centers that standard equipment and supplies, supplemented by certain nonstandard items, were usually adequate and frequently were of superior quality. One center, however, complained that the quality of instruments, particularly of cutting instruments, steadily deteriorated throughout the war. Some ophthalmologists, particularly before nonstandard items came into adequate supply after the activation of the eye centers, supplemented the Army issue by the use of their own personal instruments.

Considerable difficulty was sometimes experienced at the eye centers in the procurement of nonstandard equipment. This was particularly true when medical-supply officers, who were not qualified to judge the needs of ophthalmologists working in special centers, were inclined to disapprove requisitions for special nonstandard items. Even when the requisitions were approved, delivery, by civilian standards, was unduly slow. A binocular ophthalmoscope requisitioned in one center in 1943 was not received until December 1945. Another center operated for more than 2 years with only one slit lamp for the

entire section. When the lamp was out of commission, no examinations could be performed. When it was in commission, blind patients had to be brought from the wards to the clinic, sometimes as much as a third of a mile, and often lines of patients were waiting for examination.

As was proper, the chief supply of giant magnets was earmarked for overseas shipment, but 9 were also ordered, and eventually procured, for the 9 special centers in the Zone of Interior. For the most part, all the centers were well supplied with small Lancaster hand electromagnets, slit lamps, lensometers, complete fitting cases, Brombach perimeters, stereocampimeters, ophthalmoscopes, projectoscopes, electrocauteries, amblyoscopes, transilluminators, tonometers, phorometers, and instruments for corneal transplantation, as well as the more usual instruments, which were generally in ample supply. If fabricated items were lacking, the ingenuity of officers and technicians often produced very acceptable substitutes. In April 1945, a tonometer-testing station was established at Avon Old Farms to standardize tonometers used in Army installations.

The Berman foreign-body locator never became standard, though these instruments were used with satisfaction at the Valley Forge center, at the Wakeman center (for a short time), and at the centers at Dibble and O'Reilly General Hospitals, where they were received as gifts.

The preparation of a portable chest for refractions occupied a good deal of time and attention, but the Pacific phase of the war ended just as the chest was ready for clinical trial. It contained, among other items, a trial case, appropriate charts, a folding perimeter, a tangent screen, an electric ophthalmoscope, and a retinoscope.

Photography

Facilities for photography were not uniform in all installations, though the visual recording of the preoperative and postoperative status of all patients would have been desirable, at least at all the eye centers. At some centers, such as Baker General Hospital, a special photographic unit attached to the hospital took all pictures. At others, the photographs were taken by interested officers, who sometimes were attached to other services. At the Northington center, a nurse and a WAC technician who had formerly taught mechanical drawing made sketches at operations, prints of which were attached to the patient's chart. No retinal camera was available at this center—in fact, no Army hospital possessed a fundus camera and the ophthalmologic staff arranged at its own expense to have pictures of patients with unusual conditions of the inner eye photographed by a Memphis photographer. At this center, a moving picture entitled "Reconstruction of the Orbital Rim with Tantalum Plate" was produced, with captions. Makeshift photographic arrangements worked well in many of the centers but were not always reliable, and it is unfortunate that qualified photographers were not available in all plastic-surgery centers.

In July 1945, the Ophthalmology Branch, Office of the Surgeon General, delivered to the Army Medical Museum a collection of 250 large Kodachrome transparencies, which were reproductions of the paintings of the fundus oculi in the possession of the University of Rome. They had been procured by Maj. Trygve Gundersen, MC, while he was acting as consultant in ophthalmology in the Mediterranean Theater of Operations.

CLINICAL MANAGEMENT OF PATIENTS

Admission

Admissions to the eye centers were made directly from ports of debarkation, from other hospitals, or from other services within the hospital. The general practice of admitting all patients (except those needing immediate surgical care, psychotic patients, and patients with communicable diseases) to an admissions and disposition section did not always prove practical for ophthalmologic patients, for whom highly specialized diagnostic measures are essential. Direct admission of patients to the eye wards, particularly of patients with such conditions as retinal detachment, increased intraocular tension, penetrating injuries of the globe, and other acute conditions, permitted immediate examination and treatment.

As full use as possible was made of clinic facilities. Ambulatory patients were usually examined in the clinic; others were treated in the clinic or in treatment rooms connected with the wards, depending on available facilities. In surgical wards equipped with slit lamps, preoperative and postoperative care was carried out on the wards, thus lifting a burden from busy clinics. At some centers, each officer was assigned specific clinic hours for his patients but could bring them at other times if the facilities were not in use and if a ward secretary could accompany him to take his notes. In hospitals in which civilians were cared for, it was customary to assign one afternoon weekly to these patients and to see them at other times only in emergencies or by special appointment.

Routine of Study

The ward routine for each patient included a complete history and complete physical examination, followed by such consultations as were indicated. Routine laboratory work included urinalysis, blood count, hemoglobin determination, and blood serology. A chest roentgenogram was usually made. Special tests were carried out as indicated, such as tests for brucellosis, the Frei test for lymphogranuloma venereum, the Mantoux test for hypersensitivity to tuberculin, complement-fixation tests, and, in such conditions as uveitis and iritis, other tests to identify foci of infection in the teeth and elsewhere. Bleeding and coagulation times were determined before operation. Bacteriologic

studies were made before all intraocular procedures but otherwise were undertaken only on special indications.

Complete ophthalmologic workup included a determination of visual acuity; preliminary refraction and muscle-balance testing by the optometrist, the medical officer deciding later if more detailed studies were necessary; external examination; ophthalmoscopy; slit-lamp studies; and perimetry. If glasses were worn, they were neutralized by the optometrist when the patient was first seen.

It was a general rule in large centers, in which the personnel were likely to be of varying grades of experience and training, that all patients booked for operation should have been examined previously with the chief of section or his assistant. This policy of full discussion of all cases before operation eliminated the necessity for later justification of cases in which the indications were borderline, particularly cases in which the disabilities were not service connected.

Refractions

The policy of the individual hospital, which was usually based on the availability of ophthalmologic personnel, determined whether refractions were performed by ophthalmologic officers or by optometrists under their supervision. If the optometrists, who were usually well-trained graduates of recognized schools of optometry, performed the refractions, the ophthalmologist later determined the necessity for cycloplegia if such determinations were not part of the original routine. The ophthalmologist personally examined all obscure or unusual cases and made frequent spot checks.

Refraction was done objectively with the battery retinoscope and the usual use of spheres and cylinders. Retinoscopic findings were refined by subjective trial. A final manifest refraction was carried out a few days after the original test unless the medical officer regarded it as unnecessary.

Cycloplegic examinations were usually done by 1 of the 3 following methods: (1) Paredrine homatropine hydrobromide emulsion, 1 drop in each eye every 5 minutes 3 or 4 times or twice at 10-minute intervals, with refraction an hour later; (2) paredrine scopolamine hydrobromide emulsion, 1 drop in each eye 2 or 3 times, with refraction an hour later; (3) atropine sulfate solution (1 percent), 1 drop in each eye 3 times daily for 2 days preceding the test and 1 or 2 drops the day of the test, depending upon the time of day at which the refraction was to be carried out. Postcycloplegic examinations were usually carried out on patients who had not previously worn glasses or who required a marked change in their lenses.

Some indication of the volume of refractions done in Zone of Interior hospitals is evident in a report submitted to the Surgical Consultants Division on 10 March 1944 from 299 hospitals maintaining refraction services.[7] Over

[7] Memorandum, Maj. F. N. Schwartz for Col. B. N. Carter, 10 Mar. 1944, subject: A Study of Reports of Information Concerning Eye Examinations and the Prescribing and Fitting of Glasses.

a 3-month period, there had been 81,742 refractions per month, and the total number of spectacles prescribed per month had been 70,150. Of these refractions, 10,647 (13 percent) had been performed by medical officers, 46,043 (56 percent) by medical officers and enlisted men, and 25,052 (31 percent) by enlisted men alone. Only 25 hospitals reported that the refractions performed by enlisted men were not checked by a medical officer.

PROFESSIONAL MEETINGS

In addition to their attendance at hospital conferences, medical officers on ophthalmologic services were usually invited to meetings of local medical groups and were urged to attend them. Frequently, they participated in programs. The ophthalmologic staff of the Crile General Hospital on one occasion was responsible for the entire program at one of the meetings of the Cleveland Ophthalmological Club. The staff of the Northington center arranged a special program in April 1945 for civilian physicians; cases were presented, and slides and colored moving pictures were shown. A similar program was arranged by the staff of the Dibble center in January 1946.

A 3-day military ophthalmologic meeting was held at the Crile General Hospital Eye Center in November 1945. The attendance included representatives from all service commands, the Air Corps, and the Navy, and from local ophthalmologic groups. Dental officers were also invited because of their participation in the artificial-eye program. The program was the responsibility of ophthalmologists in the service except for two presentations by Dr. A. D. Ruedemann, chief of the Department of Ophthalmology of the Cleveland Clinic, who had served as civilian consultant for the Crile center since its activation. In addition to papers on numerous other subjects, one symposium was held on orbital reconstruction, a second on plastic surgery of the eyelids, and a third on intraocular foreign bodies. More meetings of this kind would have been extremely profitable, but the patient load, the shortage of personnel, difficulties of travel and housing, and similar obstacles made them impractical.

THE OPTICAL PROGRAM

Historical Note [8]

At the beginning of American participation in World War I, no special provision was made for supplying soldiers with glasses. Usually, if the need was established by refraction, the individual purchased the glasses through the camp exchange which was able to supply them at a reduced price because of arrangements made with certain manufacturers. This plan was fairly satisfactory, except that it was open to the criticism that the soldier had to supply himself with what was a piece of his essential equipment.

[8] See footnote 1, p. 1.

In September 1917, soon after the United States entered the war, standardization of lenses for use in military service had been begun by the Subcommittee on Ophthalmology of the Council of National Defense working in cooperation with the Office of the Surgeon General. The lens recommended for approval was flat, round, and 40 mm. in diameter. The frames were of white metal. Bids were invited on specifications, and the company whose bid was accepted furnished spectacles for sale in camp exchanges until June 1918, when the Army assumed the responsibility for their provision. The plan, which had been worked out by the Section of Ophthalmology in the Surgeon General's Office, included provision of standard frames and lenses and replacement if they were damaged in military service. If they were broken through fault of the wearer, the cost of repairs was charged against his pay. If the soldier desired nonstandard frames, he was permitted to purchase them at his own expense.

In the winter of 1917–18, while the chief of the Ophthalmology Section was making an inspection tour of American Expeditionary Forces installations in Europe, he investigated, on instructions of the Chief Surgeon of the Expeditionary Forces, possible methods of supply of lenses for overseas personnel. In his report, he noted that plans for this contingency were already on file in the Surgeon General's Office, a list of qualified opticians was available (p. 2), and the program could therefore be set in motion as soon as the necessary orders were issued. The first base optical unit and eight auxiliary units were ordered into action 25 February 1918 and arrived in France 4 May 1918. Six additional units, requested by headquarters of the American Expeditionary Forces, sailed 12 November 1918.

Institution of the Optical Program in World War II[9]

Since the optical program in World War II was conducted in cooperation with the consultant in ophthalmology in the Surgeon General's Office, it is briefly recounted here. The importance of the program is reflected in the fact that approximately 18 percent of the military personnel participating in the activities of World War II required spectacles. Many would merely have been inconvenienced by being without glasses temporarily, but many others would have been partially or completely incapacitated. Lt. Col. James N. Greear, Jr., MC, consultant in ophthalmology for the European Theater of Operations, stated in 1945 that without the optical facilities provided in that area it would have been necessary every month to evacuate approximately 10,000 soldiers who had lost or broken their glasses.[10] Maj. Trygve Gundersen, MC, the acting consultant in ophthalmology for the Mediterranean Theater of Operations, was similarly emphatic.

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[9] History of the optical program prepared by Stanley W. Rybak, Optical and Artificial Eye Section, Distribution Section, Supply Service, 28 December 1945.

[10] Semiannual Report for Ophthalmology, Office of the Chief Surgeon, European Theater of Operations, 1 January–30 June 1945.

When the military emergency began, the only provisions for purchasing spectacles for military men at Government expense were contained in paragraph 8, section III, AR 40–1705, dated 11 May 1939, which authorized the purchase only when it was necessary for the correction of visual defects resulting from violence in line of duty. That this provision was not adequate for an army increasing daily in numbers as the result of civilian inductions first became evident in a report dated 12 May 1941 from the commanding officer, Fort McClellan Station Hospital, to The Surgeon General. In this report, it was noted that 75 enlisted men in the 27th Division had broken their spectacles in the performance of military duty; that most of them lacked funds for repair; that spectacles had been prescribed for a number of other men who had had refractions at the hospital and most of whom were financially unable to buy glasses; and that both groups of men, because they were without glasses, were performing their duties with decreased efficiency.

Upon receipt of this report, the problem was taken under investigation in the Office of the Surgeon General, where the estimate was made that about 10 percent of all military personnel required spectacles, although many of them would not possess eyeglasses when they entered service. On 5 June 1941, The Surgeon General recommended to The Adjutant General that glasses be supplied to military personnel who needed them for maximum efficiency in the performance of duty. The recommendation was approved, and The Surgeon General was directed to make the necessary provisions and issue the necessary directives to carry out the proposed plan.

Supply and Issue of Spectacles

At the time the optical program was instituted, the basis of issue of spectacles was one pair to each individual, with another pair provided upon embarkation for overseas. This plan was found to impose an impossible burden upon staging areas and ports of embarkation, as well as upon optical-supply houses. Delivery overseas presented insuperable obstacles, and glasses which had to be discarded represented a financial loss of at least two-thirds of their value, since the lenses, which represented this proportion of the cost, were not salvageable. The plan was therefore adopted of issuing two pairs of spectacles to each soldier as early as possible in the training period. At the conclusion of hostilities, the basis of issue was again made one pair of spectacles to each person.

The original idea of letting contracts for the issuance of spectacles in each service command also proved unworkable. Administrative and other reasons at first made the awarding of a single contract for the provision of spectacle and frames seem more efficient. Later, when the requirements proved to be many times in excess of the earlier estimate, the second-low bidder was also awarded a contract, and production was eventually spread among nine manufacturers. Numerous subcontracts were let by these companies.

The selection of a frame had to be predicated not only upon individual comfort but also upon durability in all varieties of climate and ability to withstand hard use. These criteria seemed best met by a frame containing 18 percent silver. By July 1943, after about 190,000 pairs of spectacles had been ordered, an analysis showed that soldiers were being furnished glasses for such minor corrections as plus or minus 0.25 in one eye or the other and prismatic corrections of 0.25 to 0.50 diopter.

Prescriptions for these corrections enormously increased the work of the optical companies, and it was therefore decided by an optical board of military and civilian ophthalmologists that thereafter spectacles would be issued only for corrections of more than 1.00 diopter in any meridian in either eye. A waiver was granted shortly afterward to Army Air Force personnel, on the ground that the correction of even minor optical defects was necessary for the most efficient performance of their specialized duties. Somewhat later, the basis of issue was changed to visual acuity of less that 20/100 in either eye.

Issuance of spectacles was also permitted if, in the opinion of the ophthalmologist, they were regarded as essential for the efficient performance of duty, regardless of the degree of the visual defect. Preparation of the certificate of necessity which had to accompany each such prescription and which was found to be required in 60 percent of all cases imposed a heavy clerical burden. The rule was finally changed to a basis of issue for a correction of more than 1.00 diopter in the meridian of the greatest defect in either eye or the requirement of spectacles for the efficient performance of military duty. A certificate of necessity was still required for the latter criterion, but the adoption of efficient forms greatly simplified the clerical burden.

Special plans had to be made for the farming out of subcontracts to branch offices of parent companies unable to handle immediately all prescriptions received. Delivery of glasses, which had to be expeditious because of military necessities, was a particular problem. Strategically located branch depots devoted exclusively to military work finally proved to be the solution and also required a far lower inventory of frames and lenses.

Fitting and repair cases containing standard frames and adjustment tools were supplied to all installations. Individual fittings, however, proved impractical in more than half of all cases because of the stepped-up pace of inductions and the shortage of ophthalmologic personnel.

By the end of the war, the requirements for the Army had mounted to the provision of spectacles for 18 to 20 percent of military personnel, compared with the original estimate of 10 percent. The issuance of two pairs of glasses for each man, plus a 30-percent per annum replacement for personnel stationed in the Zone of Interior, had meant the issuance of 522,000 pairs of spectacles per annum or a total of 2,250,000 during the war years.

To deal effectively with malingerers, who were in the habit of breaking or losing their spectacles in order to delay their transfer overseas or to escape performance of their duties, the policy was established that military personnel

who broke their spectacles by design or by willful negligence would be judged guilty of a violation of the Articles of War.

Spectacles for Wear With Gas Masks

The British, because their gas masks were simple, provided spectacles which were universally useful. For use with gas masks, the Germans and the Japanese provided spectacles of the goggle variety, held close to the face by an elastic band passing around the head. The United States Army finally adopted the British-type spectacle with flat temples, but after some 100,000 had been issued it was found that leakage could occur when they were worn, and they were used thereafter only as auxiliary glasses.

After exhaustive tests, and because of the magnitude of the requirements otherwise, it was finally decided that only men with binocular visual acuity of 20/70 or less should be fitted with spectacles for use under gas masks. The spectacles required most careful fitting, which could not be carried out uniformly. Also, they easily became maladjusted. Delivery at the port of embarkation was associated with the same difficulties as the delivery of other spectacles by this route, and eventually gas-mask spectacles were issued as soon as a unit was alerted, so that 4 to 12 weeks' leeway was allowed.

Even the altered glasses were found to permit leakage and to be uncomfortable to wear, and a new design was therefore adopted, consisting of a 40-mm. eye wire supported by three brackets in a frame inserted beneath the gas mask next to the lens. This design was also far from ideal, and the future solution of this problem would seem to be the designing of a gas mask which can accommodate an ordinary pair of spectacles.

In all, approximately 7 percent of all military personnel required spectacles which could be worn with gas masks, and a maintenance factor of 30 percent was calculated. The necessity of distributing many of these glasses to troops already overseas posed such problems that it seemed obvious that in the future provisions should be made for their manufacture and distribution when troops are first alerted for overseas duty.

The Overseas Optical Program

The first mobile optical-repair unit designed for service overseas consisted of a 2½-ton truck, with a stake body; it did not include surfacing equipment. After eight units of this kind had been put into operation, it was realized that a self-contained unit, in which operations could actually be carried out in the truck, would be more efficient, and that surfacing equipment was essential. A truck meeting these requirements was designed, with all equipment permanently mounted on benches which were permanently mounted on the floor of the truck. Although removable equipment might have been more desirable, this arrangement proved quite satisfactory.

Base shop optical-repair units were issued to service troops housed in stationary installations, and a portable optical-repair unit was also designed which, though not satisfactory in several respects, was used throughout the war. The original issue of one mobile and two portable units to each medical-supply depot was found to result in an extravagant waste of facilities, and the ideal basis of issue was determined to be one mobile and two portable units for each 200,000 scattered troops or one mobile unit for the same number of concentrated troops. Base shops were located in England, Paris, Manila, and Australia. Only one overseas unit, on the German front, was destroyed by enemy action, though eventually about 50 were at work in the theaters of operations. The work was done chiefly behind the lines, but in a few instances the units operated in forward areas or even went forward with initial invasion forces, such as the Seventh U. S. Army in southern France.

All personnel attached to these units were opticians who had followed that occupation in civilian life and who had been trained in military techniques at a training school established at the medical depot in St. Louis. Officer personnel had had experience in managing civilian optical shops. Qualified personnel was always in short supply, and eventually optometrists had to be trained for this purpose. Consulting ophthalmologists in active combat theaters had the overall responsibility for coordinating all activities of optical-repair units.

Stockpiles of all necessary material and equipment for overseas units were established at the Binghamton Medical Depot. The European theater was provided with a stockpile of its own, which supplied the 20 units operating in the theater. Requisitions to the Binghamton Depot from overseas were processed in the Surgeon General's Office. It was thus possible to correlate information concerning the type of equipment utilized and the foci most frequently prescribed, to maintain a control on requisitions, and to see that repairs and replacements were limited to standard items. Supplies were usually adequate, though in the North African invasion they arrived somewhat slowly and ingenious improvisations had to be employed, such as the use of desert sand in place of rough emery.

Special Types of Glasses

No overall program for the use of a contact lens was ever considered, because the time factor and the unpredictable results of the use of these special glasses made it impracticable. Occasionally such lenses were prescribed for a soldier whose disability had been incurred in combat or whose status was definitely "Line-of-Duty-Yes." Cases of this sort were always managed on an individual basis. The same policies were employed for telescopic and aniseikonic lenses. A program of hardening lenses was not adopted, and experimental work begun on nonglare lenses was not completed.

Record of Prescription

Early in 1942, when it became apparent that a great deal of time and effort were being expended in the replacement of lenses which had been lost or broken, the need became obvious for a permanent record of visual acuity, of the corrective prescription, and of the size and type of frame suitable for each individual. These data were finally incorporated on WD AGO Form 20 (Soldiers' Qualification Card) for enlisted men and on the immunization record for officers. Many repetitious examinations were thus eliminated. It was also believed, though no action was taken, that it would be wise to have a permanent initial record of visual acuity attached to the soldier's person, if only as a valid basis for the later adjudication of claims for pensions. The practice of having the record on the soldier's person was followed in other armies, and the objection raised that the United States soldier would lose it was not thought to be sound.

THE ARTIFICIAL-EYE PROGRAM

Historical Note [11]

In August 1917, the Subcommittee on Ophthalmology of the Council of National Defense became interested in the supply and manufacture of artificial eyes for the Army. The glass used in their manufacture had, for the most part, come from Germany and had never been made in the United States, because of the limited demand for it. Samples of the manufactured glass were obtained with a good deal of difficulty, and a series of conferences on the subject, chiefly concerned with chemical problems, was initiated with the Bureau of Standards, the Geophysical Laboratory, manufacturers of glass, and firms dealing in artificial eyes. Sample glass eyes were ultimately produced which, while adequate for the purpose, were not equal in quality to the finished products of German manufacturers. Further experiments were discontinued when a survey, made in cooperation with the Office of the Surgeon General, revealed that the stock of artificial eyes carried by various dealers in the United States would probably be equal to Army demands.

Some of the eyes in stock in the United States were included in the equipment of the first optical unit sent overseas (p. 28). The remaining stock was later divided among various eye centers in the United States. If a soldier in the Zone of Interior needed an eye and had not been assigned to a specialized hospital, authorization was given to purchase the prosthesis from the nearest civilian shop dealing in artificial eyes.

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[11] See footnote 1, p. 1.

Institution of the Artificial-Eye Program in World War II

The need for artificial eyes in World War II did not become apparent until late in 1943, when battle casualties requiring prostheses began to appear in Zone of Interior hospitals and when, in addition, the Army began to induct one-eyed men. Exact figures were not available for either group at the time of writing, but it has been estimated that between 8,000 and 10,000 men with only one eye were inducted into service.

In the early days of the war, when there was only occasional need for artificial eyes, purchases were made, as the need arose, on the open market. As demands increased, contracts were let with the larger companies for both stock and custom-made eyes. The issue of custom-made eyes was confined to Halloran, Gardiner, and Dibble General Hospitals. This program, however, soon proved unsatisfactory. The utilization ratio of glass eyes is extremely low; to fit approximately 1,000 persons, a stock of several hundred thousand eyes must be carried. There was always a delay between the breaking of the eye and the procurement of a stock replacement. Moreover, if a stock eye was issued, the soldier desiring to escape service could always complain that it was not comfortable. He could not be contradicted on this point, any more than it could be proved that he had broken the eye by design originally, since glass eyes are notoriously fragile. If he had to be sent to one of the general hospitals in which custom-made eyes could be secured, delays of as long as 8 weeks before the glass eye was issued were not at all unusual.

The issuance of the replacement did not solve the problem. There was nothing to prevent the soldier from breaking it again, and many instances were called to the attention of the Surgeon General's Office in which some individuals, over a period of a year, had been fitted with three or four glass eyes and had spent 6 to 8 months in hospitals while the eyes were being provided. Moreover, all glass eyes, whether stock or custom made, become etched in the fluids of the socket and roughen and become discolored after 18 to 24 months of use. Extensive replacements as well as the initial issue therefore had to be provided for. Finally, there were not in the United States in 1943 more than six firms capable of making custom-made glass eyes, and since, as in World War I, the chief stock of materials as well as of eyes came from Germany, available stocks promptly became depleted. These circumstances, combined with the expense of custom-made eyes, the loss of man-days while they were being procured, and the cumbersome process which required reference to a hospital which was frequently at a great distance, all made some other plan of procurement desirable.

Part of the stock of glass eyes available in the United States was shipped overseas, and requisitions for additional supplies could be made, as necessary, from the large central stock maintained at the medical depot at Binghamton, N. Y. This stock was broken down into four sizes (small, medium, medium large, and large) and into five colors (brown, green, hazel, blue, and Negro brown), with each color further broken down into three shades. In spite of

the apparently large range of choice, the dissipation of the supply among numerous hospitals in the European theater made the actual range of choice relatively small, and it was frequently difficult to match the intact eye. Abnormal temperatures added to the percentage of breakage, while the shipment overseas of one-eyed men further increased the difficulties of matching and supply.

Development of the Acrylic Eye [12]

The development of the acrylic eye solved these difficulties. Acrylic (methyl methacrylate), which is a clear synthetic resin, had been in use for some years before the war for the construction of artificial dentures. It is strong, well tolerated by human tissues, and readily formed into irregular shapes. Not surprisingly, the idea of using acrylic for ocular prostheses seems to have occurred to several persons at about the same time.

The pink acrylic resin used for dentures was used as early as 1941 for temporary prostheses to maintain the form of the socket after removal of the eye until a permanent prosthesis could be placed. The first satisfactory acrylic eye was apparently produced by Capt. Stanley F. Erpf, DC, while he was on duty with the 30th General Hospital in England. Exactly how many investigators, military and civilian, worked on this problem is not known, but, about the same time that Captain Erpf was working in England, Maj. Victor H. Dietz, DC, and Maj. Milton S. Wirtz, DC, were working along similar lines at Thomas M. England General Hospital, Atlantic City, N. J., and at Camp Crowder, Mo. They also produced satisfactory acrylic eyes, though apparently a little later than Captain Erpf.

Early in 1944, while on a trip to the European Theater of Operations, The Surgeon General, Gen. Norman T. Kirk, learned of Captain Erpf's work. On his return to the United States, General Kirk arranged for orders for Captain Erpf to report to Valley Forge General Hospital, together with Major Dietz and Major Wirtz and several technicians, with the objective of developing a standard technique. By the end of September 1944, an eye had been developed which was regarded by every ophthalmologist who observed it as superior in every respect to all previous types of ocular prostheses. The iris of the acrylic eye more exactly duplicated the appearance of the human iris. The fit was more exact. The eye was not breakable. It could be worn for long periods of time before it was necessary to change and clean it. Since acrylic is not susceptible to temperature changes, the patients were much more comfortable. Experimental studies suggested that the expected life of the acrylic eye might be set at approximately 5 years.

After some hundred patients had been fitted with acrylic eyes and had all expressed themselves as completely satisfied with them, this type of prosthesis

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[12] Jeffcott, G. F.: Medical Department, United States Army. United States Army Dental Service in World War II. Washington: U. S. Government Printing Office, 1955, pp. 235-237.

was adopted as the exclusive type of ocular replacement by the Army and, later, by the Veterans' Administration.

Twelve members of the Dental Corps were taught the process of making acrylic eyes at the Valley Forge General Hospital by the Dental Corps officers who had devised the original models. These newly instructed officers were then ordered to 12 general hospitals strategically located throughout the country, where they set up laboratories for the making of acrylic eyes. Additional officers were trained and assigned as the need for eyes increased, and by July 1945 laboratories for this purpose were operating in 32 general hospitals in the United States. Exactly how many acrylic eyes were produced is not known, but, by the end of October 1945, approximately 7,500 casualties in the Zone of Interior had been supplied with them, and Captain Erpf estimated that about 10,000 eyes had been made in the first 18 months of the program.

After a satisfactory model of plastic eye had been developed in the Zone of Interior, a training school was opened in the European Theater of Operations to supply theater needs. After the program had been well established in the Zone of Interior, officers trained in the Valley Forge laboratory were sent over to assist in the work there.

Other Prosthetic Devices

Acrylic lent itself so admirably to prosthetic devices that several were developed in the course of the war. An artificial cornea and anterior chamber developed at the O'Reilly eye center could be placed over the painted iris to provide a realistic idea of what the disk could look like in the finished eye. At the same installation, an acrylic contact device was made which, when fitted over a corneal leukoma, gave the defective eye the appearance of the intact eye. At the Dibble eye center, a basket type of orbital implant, to which an acrylic prosthesis could be later attached, was devised to permit wider motion. A doorknob basket implant which permitted almost perfect motion in the prosthesis was also devised.

RECOMMENDATIONS

The experience in ophthalmology in World War II prompts the following recommendations, to go into effect at once in the event of another national emergency:

1. A consultant in ophthalmology should at once be placed on active duty in the Office of the Surgeon General.

2. Upon the activation of each overseas theater, a consultant in ophthalmology should at once be placed on duty and 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, the chief of the center (presumably an ophthalmologist of out-

standing qualifications and competence) should serve part time as consultant in ophthalmology within the command. In particular, he should advise the command surgeon on the qualifications and assignment of ophthalmologists. The policy of having only the surgical consultant or only 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 blinded casualties should be immediately appointed. 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 could probably serve as well in a civilian as in a military capacity. In World War II delay in the appointment of a consultant in charge of blinded casualties seriously delayed the program.[13]

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 from this section, thoroughly experienced in the problems of optical and medical supplies and with special familiarity with the spectacle program, should be assigned to the office of the consultant in ophthalmology in each overseas theater.

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

7. Overseas consultants should submit monthly reports to the consultant in ophthalmology in the Office of the Surgeon General. Abstracts of these reports would be incorporated in a monthly newsletter for distribution to overseas and Zone of Interior installations.

8. During mobilization and basic training, all medical officers should receive some instruction in traumatic ophthalmology. More advanced work could be made available in refresher courses.

9. Both globes should be included as part of the pathologic material removed at all autopsies.

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

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[13] The program for the care and rehabilitation of blinded casualties, which was an important phase of the work of the Ophthalmology Branch in the Office of the Surgeon General, is described in detail elsewhere in this volume (ch. IX).

CHAPTER II

General Clinical Policies in Ophthalmology in Zone of Interior

M. Elliott Randolph, M. D.

The discussion in this chapter is concerned with general principles of management of the important medical and surgical ophthalmologic conditions encountered in Zone of Interior hospitals during World War II. It is not intended to be definitive or inclusive.[1] A more detailed discussion of certain of these conditions appears elsewhere in this volume under appropriate headings.

MANAGEMENT OF SPECIAL CONDITIONS

Intraocular Hemorrhage

Intraocular hemorrhage confined to the anterior chamber usually cleared up promptly and presented no special problem. Cases of diffuse hemorrhage were in another category. Methods of management included absolute bed rest, the administration of calcium salts and vitamin K, and local diathermy. The intraocular pressure was carefully observed, and paracentesis was performed and the retained blood washed out if the pressure increased. In the most severe cases, a small limbal incision was sometimes employed. A vitreous transplant was occasionally used, but the operation was not generally looked upon with favor. Unfortunately, when the tension was normal, it was not possible to predict in which cases absorption would occur and in which active therapy would be necessary. In longstanding cases in which intraocular pressure was normal, treatment consisted of the use of hot compresses and atropine.

In severe cases, especially those of traumatic origin, the results of treatment were seldom spectacular. Vision improved from hand movements to 20/30 in a few instances, but as a rule good results were obtained only in patients in whom the hemorrhage was confined to the anterior chamber.

Patients with recurrent hemorrhage into the vitreous (Eales's disease) accompanied by periphlebitis, retinitis proliferans, and other complications, were discharged to the Veterans' Administration for continued observation, since this condition is not in the usual category of intraocular hemorrhages.

[1] A statistical presentation of diseases and injuries of the eye in the United States Army during World War II is contained in appendix A, pp. 549–556.

Uveitis

The importance of uveitis in military ophthalmology is evident in the number of cases handled during World War II. At the O'Reilly General Hospital Eye Center alone, for instance, during its approximately 2½ years of operation, some 400 patients were admitted with this condition. The inflammation was active in about 250 of these cases, and the disease was idiopathic in approximately the same number, though in numerous other instances multiple possible etiologic factors were identified.

The general principles of management were as follows: In traumatic cases, the overseas record was reviewed, and such additional examinations were carried out as seemed indicated. In nontraumatic cases, every attempt was made to identify the cause. The workup always included a thorough search for foci of infection by means of routine tests supplemented by such special methods as agglutination tests for brucellosis and the Mantoux (Mendel) tuberculin test. Roentgenograms of the chest and teeth were also taken. Consultations were requested in most cases, including consultation in respect to possible allergic factors.

Routine treatment was about as follows:

1. The focus (foci) of infection was actively treated, whenever it could be located.

2. Cycloplegics were instilled to keep the eye at rest and prevent the formation of posterior synechiae.

3. Salicylates were used to control pain.

4. Nicotinic acid was administered for its vasodilating effects.

5. If the uveitis was active and moderately severe, sulfadiazine and penicillin were given in combination for at least a week. When the disease was chronic, these agents were not useful and were not administered.

6. Nonspecific foreign protein therapy was employed in several forms, with triple typhoid vaccine being used most frequently. Although excessively high temperatures were not sought, a fever of at least 102° F. was desired. It was not always easy to attain this temperature in young and otherwise healthy men. The course of typhoid vaccine injections was sometimes repeated.

Fever therapy was used when equipment and personnel were available. At the Crile General Hospital Eye Center, where facilities were not available, very good results were obtained from hot baths given under the supervision of the physiotherapy department.

Injections of boiled milk were given at some centers as part of the foreign protein therapy. In other centers, a course of desensitization was carried out if the uveitis was of low grade, no focus of infection was found, and the first tuberculin test was positive.

Disposition varied according to the severity of the condition and the

results of treatment. If the patient had experienced only a single attack, if he responded promptly to therapy, and if the lesion was small and the involved area neither affected central visual acuity nor caused material constriction of the peripheral visual fields, he was returned to duty after the process became quiescent. Patients with severe diffuse disease which responded slowly to treatment and patients with a history of recurrent attacks were discharged for disability. If tuberculosis was suspected or proved as the etiologic factor, the patient was discharged to the Veterans' Administration for periodic observation and treatment, as necessary. Periodic observation was also advised for all patients separated from service because of uveitis.

Retinal Detachments

The number of cases of retinal detachment encountered in eye centers in the Zone of Interior during World War II was very large. In addition to these cases caused by direct injury during training and in combat, the number of men inducted into service automatically resulted in a correspondingly large incidence of so-called idiopathic retinal detachments. Retinal detachments resulting from penetrating wounds varied in number with the tempo of the war, with several months often elapsing between direct injury or the appearance of symptoms in overseas theaters and admission of the patient to an eye center in the Zone of Interior. In a small number of cases, retinal detachment *followed the surgical removal of a foreign body.*

The statistics of retinal detachments are not likely to be perfectly accurate; the inaccuracies tend to balance each other. The clinical diagnosis, particularly in the early months of the war, was frequently made on insufficient evidence, probably because many medical examiners had had no opportunity in civilian life to become familiar with the traumatic lesion. In numerous cases, on the other hand, when extensive damage to the eye prevented detailed examination, it is probable that the diagnosis was overlooked. This was particularly likely to happen when the detachment was a result of injury by explosive weapons.

In all suspected cases of retinal detachment, the patient was examined as promptly as possible, both with and without mydriasis, and visual acuity and fields were determined. If the diagnosis was confirmed, he was immediately put to bed, treated with a cycloplegic, and supplied with Lindner or other goggles. In numerous instances, the eye was so disorganized that surgical intervention could not be considered. When operation was planned, the tear or hole was localized, and ophthalmoscopic examination to confirm the previous findings was repeated immediately before operation, so that the surgeon would be fully oriented. Sketches and diagrams of the affected area proved helpful.

Operation was usually carried out under Pentothal Sodium (thiopental sodium) anesthesia. Chemical cauterization (Guist) was used in a few cases,

but electrocauterization was generally preferred. The technique varied widely, according to the surgeons' civilian preferences and practices. The following methods were employed:

1. At the Dibble center, the Walker diathermy method was employed. A Lacarrere handle or a Weve electrode was employed, and the fluid was evacuated through a diathermy hole.

2. At the Crile center, the Liebel-Flarsheim unit was used, the single insulated tip being preferred. Extensive barrage of the involved area was performed. In a few isolated cases, this procedure was combined with surface coagulation in the area of the tear with the ball tip electrode. Scleral resections (scleral shortening) were performed at the time of original surgery if the tears were large, on the theory that the eye could tolerate this operation better as an original procedure than as a last resort.

3. At the Cushing center, multiple scleral punctures were made with the diathermy unit over the area of detachment, with particular concentration at the actual site of the tear. Sclerotomy was done near the equator. The fundus was examined, and such further procedures were carried out as seemed necessary to reattach the retina.

4. At the O'Reilly center, the Schoenberg diathermy apparatus was connected to a Bovie surgical unit. After the area of sclera corresponding to the retinal hole had been localized through a transconjunctival incision, surface coagulation was carried out in such a manner as to surround the rent. The coagulating current was used, and the maneuver was carried out under ophthalmoscopic control. The sclera was then penetrated by means of the cutting current, the area selected as the site of penetration corresponding as closely as possible to the area of greatest detachment. Following the initial escape of subretinal fluid, gentle suction was applied over the through-and-through scleral wound to insure that as much fluid as possible would be evacuated.

5. At the William Beaumont center, Walker platinum points and the Lacarrere electrode were used in conjunction with the small Bovie units.

6. At the Valley Forge center, the Weve monopolar electrode with needle point or ball electrode was connected with the Walker diathermy set for surface diathermy. Walker pins were occasionally used. If fluid was not obtained readily, a lacrimal dilator was inserted into one or more puncture points to secure adequate drainage. The Guist operation was used in a few cases in which other methods had failed.

It was a rather general policy to recommend disability discharge for all men with retinal detachments, regardless of the success of operation or the amount of vision in the remaining eye. The possibility of recurrence of the detachment was regarded as so great that even limited duty was not usually considered practical, though occasionally it was permitted, on a tentative basis, when the results of treatment had been unusually successful and vision in the opposite eye was good.

Glaucoma

The incidence of primary glaucoma in men of military age was naturally not great. On the other hand, because of the large number of men in the Armed Forces, this condition was encountered with a fair degree of frequency, since glaucoma is by no means unknown in younger persons. If it could be determined definitely that the patient was suffering from primary glaucoma of either the noncongestive or congestive type, and if the tension could not be controlled by intensive use of mioties, an iris inclusion operation was usually the preferred method of treatment. Massage and miotic therapy were continued after operation. In a few instances, Elliott trephine operations were performed.

Secondary glaucoma, which was a not infrequent sequel of trauma, was treated by basal iridectomy, cyclodialysis, and cyclodiathermy. In a few patients, the increased intraocular tension could be controlled by repeated paracenteses. Otherwise, the principle of treatment was the uninterrupted treatment of the underlying cause of the glaucomatous condition.

Cataracts

The senile type of cataract was not often observed on ophthalmologic services in World War II, for the obvious reason that it is not a common disease of men of military age. The few cases seen in older men followed the usual civilian pattern.

By far the largest number of cataracts observed at the eye centers in the Zone of Interior followed contused, perforating, and penetrating wounds of the eye; foreign bodies in the lens; and siderosis or chalcosis associated with foreign bodies which might or might not have entered the lens. Complications in these cases included anterior or posterior synechiae, chorioretinal damage, luxation with or without glaucoma, hemorrhage into the vitreous, and retinal detachment.

A few instances of congenital (zonular-perinuclear) cataracts were observed in the eye centers. They occurred chiefly in two classifications of patients—those whose visual acuity had diminished during their service until it was below the minimal standards for induction and those suffering from lenticular opacity which, on examination with the slit lamp, seemed to be progressing.

Operation for the senile variety of cataract usually consisted of simple or combined intracapsular extraction with corneoscleral sutures. It was the practice to explain to all patients with unilateral cataract and good vision in the other eye that removal of the cataract might be followed by double vision or by interference with vision in the good eye because of blurred vision in the aphakic eye. After this explanation, most patients preferred to maintain their current status. The few who requested operation for cosmetic reasons were not always satisfied with the results.

Recent cataracts of traumatic origin were usually treated by linear extraction, either in a single stage or in two stages. If the two-stage procedure was used, the capsule was opened in the first stage, and the lens material was irrigated from the anterior chamber in the second. Some patients responded well to single or multiple discissions with the Ziegler or Wheeler knife, sometimes followed, within 24 hours, by secondary linear extraction. Ophthalmologists in some centers preferred to reserve needling for the correction of secondary cataract membranes. Multiple discission was not free from danger. It might be followed by infection, iridocyclitis as the result of manipulation, and retinal detachment. It also had the disadvantage of requiring longer hospitalization than other methods of treatment.

Corneal Opacities

Corneal opacities encountered in the course of the war were usually the result of burns from chemicals, flames, or molten metals.

Keratoplasty for corneal opacity did not assume great importance in the eye centers of the Zone of Interior in World War II. War Department Technical Bulletin (TB MED) 177, issued in July 1945, dealt with the indications and contraindications for this operation and for keratectomy, and during the same month Valley Forge and Dibble General Hospitals were designated as centers for this type of ophthalmic surgery.[2]

Following the publication of TB MED 177, a number of patients with corneal opacities who were considered candidates for keratoplasty were sent to the Dibble and Valley Forge eye centers. In every instance, the opacities were monocular, and vision was good in the other eye. It was therefore the opinion of the chiefs of the eye services at these installations that keratoplasty would not have been justified in these cases, and most of the men were discharged on Certificate of Disability. Up to 1 January 1946, no keratoplasty had been performed at the Dibble center, though several patients were then under consideration for the operation. When the Valley Forge center had its highest census of eye patients, in August 1945, the operation was regarded as indicated in only three cases. Castroviejo's technique was used in all three cases; in one instance of keratoconus, which had developed in the Army, a secondary operation was necessary, and a 5-mm. trephine was used. The other two patients had chemical burns. Although each of the patients had been considered an unusually favorable prospect, the results in all three cases were entirely unfavorable.

At Valley Forge General Hospital, two patients were treated by superficial keratectomy to eliminate extensive vascularization in scarred corneas, and, on 1 January 1946, it appeared that it would be necessary to control extensive corneal vascularization in three additional patients by either this method or by diathermy or the use of the actual cautery.

[2] War Department Circular No. 216, sec. IV, 19 July 1945, subject: Keratoplasty and Keratectomies.

Vernal Catarrh

Patients with vernal catarrh were treated by the methods ordinarily employed in civilian practice, that is, with adrenalin solution, estevin, and other vasoconstrictors. Carbon dioxide snow was occasionally used, and, toward the latter part of the war, some patients were treated by beta irradiation.

There was a strong feeling among ophthalmologists that men with this condition should not be accepted for military service or, if they were accepted, that they should be separated as soon as the diagnosis of vernal catarrh was established and they had received maximum hospital benefits. Patients with this disease were likely to be incapacitated for 3 or 4 months each year, and the aggregate disability was great, while the drain on hospital facilities was equally large and not very rewarding.

Strabismus

Operations for strabismus were discouraged except in unusual circumstances, chiefly when it was felt that the soldier's mental attitude might be improved and his personality difficulties simplified by the correction of the condition. The operation was never performed until a complete neuropsychiatric examination had been carried out and the neuropsychiatrist had concluded that surgery would be beneficial.

When the procedure was permitted, it was usually carried out by the Reese resection or the Jamieson recession technique. The *O'Connor cinch* operation, tendon tucks, and free tenotomies were not viewed with favor.

Orthoptic training was regarded as completely impractical under military circumstances.

PREOPERATIVE AND POSTOPERATIVE MANAGEMENT

Preoperative Measures

In addition to a complete history and physical examination and routine laboratory tests, preparation for operation included bacteriologic studies in the presence of conjunctivitis or other gross infections, unhealed wounds, draining sockets, and similar conditions. In some installations, bacteriologic studies were made before any type of intraocular surgery was undertaken. The most usual organism identified was *Staphylococcus hemolyticus*. Good results in such infections were frequently reported from the local use of penicillin ointment and silver nitrate.

Whenever possible, nonemergency surgery was deferred until the patient was in optimum physical condition. Special care was taken to guard against respiratory infections, particularly during the season when they were likely to be widespread. Active foci of infection, such as apical abscess, subgingival

infections, Vincent's stomatitis, infected tonsils, and sinusitis were treated intensively.

An endeavor was also made to protect patients from emotional disturbances before operation. All were told when the procedure was to take place and were also told, in a general way, what was planned and what it was hoped could be achieved. If a patient seemed unduly apprehensive, the operation was thoroughly discussed with him and as much reassurance as was warranted was given to him.

In many eye centers, the precaution was taken, before all intraocular operations, of testing the patient's reaction to the commonly employed sedatives, anodynes, and hypnotics. These tests, which were carried out a few days before operation, prevented the occasional acute delirium or vomiting by which an idiosyncrasy to a drug might be manifested and which might well result in the loss of the eye after operation as the result of trauma or hemorrhage.

The night before operation, the patient was given a light supper, a soapsuds enema, and a sedative by mouth, usually Nembutal (pentobarbital sodium) or Seconal (secobarbital). At some installations, the eyes were irrigated with copious amounts of physiologic salt solution or boric acid solution after the instillation of Argyrol (15 percent).

On the morning of operation, breakfast was omitted unless the procedure was scheduled late in the day. A light breakfast was permitted in such cases. The enema might or might not be repeated. Sedation, administered 30 to 60 minutes before operation, consisted of Nembutal (0.1 to 0.2 gm.) or Sodium Amytal (0.3 gm.). If Seconal (0.1 gm.) was used as the sedative agent, it was administered 90 minutes and again 30 minutes before operation. If an apprehensive patient was not to be operated on until late in the day, he was often given a small dose of Seconal early in the morning.

Morphine was not ordinarily employed before minor surgery. Before major surgery, it was usually employed in appropriate doses, combined with Hyoscine (scopolamine) or atropine. Atropine was always administered if endotracheal anesthesia was to be used. At the Northington General Hospital Eye Center, morphine, 16 mg., given by vein just before operation, was found to reduce pain during the procedure to a minimum. The same plan was used at the Baker General Hospital Eye Center, where 1 cc. of Prostigmin (neostigmine) was added to the intravenous medication.

Before operation for retinal detachment, it was the practice at all the eye centers to keep patients at bed rest for varying periods of time, ranging from 2 or 3 days to 14 days. The supine position was usually favored, though some surgeons preferred to vary the position so as to encourage spontaneous reattachment of the detached retina. Stenopaic spectacles were usually worn during the period of bed rest, but at one center atropinization for 7 days was substituted for them.

Local preparation.—In most eye centers, local preparation was carried out in the operating room, though in some the face was scrubbed with tincture of green soap and water on the ward 2 or 3 hours before operation and the lashes were clipped. The routine of preparation was in general as follows: The eyelids and the adjacent areas of nose and cheek were thoroughly cleansed with tincture of green soap and water. Argyrol (15 to 25 percent) was instilled into the conjunctival sac and was followed by irrigations with boric acid solution. The skin was then painted with Merthiolate (thimerosal) solution. A towel was fastened around the head to keep the hair out of the operative field, and an eye drape with a central opening was placed over the face and head.

Postoperative routine.—The patient who had undergone intraocular operation was returned to bed on a litter with both eyes bandaged, while a nurse, medical officer, or experienced aidman supported the head. Transfer from the litter to the bed was effected with as little disturbance as possible. The patient was kept at strict bed rest, either supine or in a low semireclining position, sometimes with the head supported by sandbags. After an operation for retinal detachment, the head was elevated or depressed according to the site of the detachment. As a rule, no movement in bed was permitted for at least 8 hours after operation, and, in some installations, after any surgery of consequence, the patient was not allowed to turn on to the unoperated side until 24 hours had elapsed.

A bell was kept within easy reach of the patient so that he could summon an attendant at once. He was frequently observed, particularly during sleep, to be sure that the bandage was not displaced. Smoking was forbidden unless an attendant could be with the patient continuously until the cigarette was finished. This rule was strictly enforced, as violation obviously constituted a hazard to the whole hospital as well as to the patient.

Nurses were instructed to report immediately to the ward officer any vomiting, cough, elevation of temperature, sudden pain in the operated eye, or evidence of bleeding. They were also warned that patients with both eyes bandaged, particularly older patients, sometimes developed acute delirium. Under these circumstances, the bandage was removed from the unoperated eye, and the ward officer was notified immediately.

Pain was controlled as necessary by aspirin, Seconal, codeine, or occasionally morphine. Patients inclined to be nervous and apprehensive were given phenobarbital (0.1 gm.) 3 or 4 times daily. Measures were taken to secure sound sleep at night.

For the first 24 hours after operation, only liquid diet was permitted. Soft diet was then given, with full diet a day or two later unless some contraindication existed. Patients who had undergone such procedures as retinal reattachment were usually given a liquid diet for 7 days and a modified soft diet for another 7. If both eyes were bandaged, the patient was fed.

Bathroom privileges were permitted immediately after surgery to patients who had undergone minor operations and who had one eye uncovered. Such privileges were forbidden after all major operations until the patient was fully ambulatory. Strict attention was paid to elimination. Catheterization to avoid distention of the urinary bladder was resorted to promptly if simple measures to induce voiding failed. Enemas and laxatives were employed as necessary.

The special postoperative routine depended upon the type of operation. Patients were usually allowed out of bed the second day after extraocular operation and were ambulatory thereafter. In most instances, the unoperated eye was not covered.

After intraocular procedures, bed rest was continued for longer periods. After operations for retinal detachment, patients were kept in bed for 14 to 30 days, and postural methods were used to favor reattachment of the retina. When ambulation was permitted, it was allowed only for brief periods at first, then in gradually increasing amounts. Both eyes were kept bandaged for periods varying from 7 to 30 days, and stenopaic spectacles of some type were used for the next 30 to 90 days. On their discharge, the patients were warned against violent movements and strenuous exercises.

After cataract operations, patients were kept in bed for 7 to 12 days. In some eye centers, they were permitted convalescent furloughs at the end of 14 to 18 days. After corneal transplantation, patients were kept at rest in bed for 14 to 21 days.

The first dressing after an intraocular procedure was usually carried out on the third or fourth day after operation except in procedures for retinal reattachment, when it was usually deferred for a week. After the first dressing, the wound was usually dressed daily or every second day. Sutures were, in general, removed between the sixth and eighth postoperative days. If corneoscleral sutures were used in cataract operations, they were removed between the 8th and 12th days.

ANESTHESIA

Local analgesia was more widely employed in some eye centers than in others, but in general the practices in respect to anesthesia were routine. Pontocaine hydrochloride (tetracaine hydrochloride 0.5 percent) was usually used for topical analgesia and procaine hydrochloride (2 percent solution) for infiltration of tissues. Adrenalin 1/100 was usually added to the latter solution in the amount of 1 minim per 2 cc. of fluid.

Endotracheal anesthesia was achieved with ether, which was also used in simple inhalation anesthesia for some operations. Thiopental sodium, however, was widely favored for such operations as enucleation, evisceration, secondary implants, diathermy coagulation, operations on the extraocular muscles, and some plastic procedures.

CHAPTER III

Administrative Aspects of Ophthalmology in the Mediterranean Theater of Operations

Trygve Gundersen, M. D.

PERSONNEL

In World War II, there was no full-time consultant in ophthalmology in the Mediterranean (formerly North African) Theater of Operations. Maj. (later Lt. Col.) Trygve Gundersen, MC, acted as consultant, on a temporary basis, during 1944 and 1945, while making a survey of the ophthalmologic services in the Mediterranean theater. At the same time, he maintained his connection with the 6th General Hospital, in which he was chief of the ophthalmologic section. During the first survey in January and February of 1944, he was accompanied, for part of the time, by Lt. Col. Walter H. Potter, SnC, Office of the Surgeon General. Colonel Potter collected much of the material dealing with the optical program and allied matters.

At the time of the first survey in January and February 1944, there were in the theater 94 medical officers who, according to their records, had some specialized knowledge in the field of ophthalmology. Seven of these officers were well-trained and highly experienced ophthalmic surgeons.

During the survey, 68 of the medical officers doing ophthalmologic work were interviewed, and their work was observed. Of this group, 10 were diplomates of the American Board of Ophthalmology. Of the 68, 37 were thoroughly trained, though of varying degrees of experience, and 31 were only partially qualified.[1]

It was apparent, from the distribution of these officers at the time of the survey, that casualties with injuries of the eye could not be brought under the care of the best trained and most highly experienced ophthalmic surgeons as rapidly as was desirable. This was extremely unfortunate, especially in respect to perforating wounds, because the first operation on an injured eye is almost always a definitive one.

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[1] The papers of one captain in this group indicated that he had been certified by both the American Board of Ophthalmology and the American Board of Otolaryngology. The quality of his work in ophthalmology was quite at variance with certification by the American Board of Ophthalmology, and information concerning his qualifications was requested from the Secretary of the Board. The reply revealed that he had not taken the examination for certification and, in fact, had never applied to take it. He was subsequently placed in a less responsible position.

Some of the difficulties in the distribution of medical officers were due to the fact that, from the standpoint of ophthalmology, tables of organization for hospitals in World War II were a carryover from World War I, when a single medical officer was responsible for both ophthalmology and otolaryngology. In the interim between the wars, these specialties had developed independently.

The fundamental cause of maldistribution of ophthalmologists in the Mediterranean theater, however, was failure to recognize that the need of a military hospital for an ophthalmologist of particular training and experience depended upon the special mission of the hospital. For example, a well-trained and experienced ophthalmologist was needed in every general hospital to care for patients on the eye service; furnish consultation service; and administer the outpatient department, in which refractions were done and ambulatory patients with minor ocular complaints were treated.

Evacuation hospitals were quite as much in need of well-trained and experienced ophthalmologists as were general hospitals. It was estimated that, of every 100 battle casualties admitted to an evacuation hospital in the Mediterranean theater, approximately 3 would have serious eye injuries. It was recognized that the only chance of saving the eyes of a number of these casualties lay in early definitive surgery. Therefore, it was imperative that properly trained ophthalmologists be available to meet these needs. Although, at the time of the January 1944 survey, ophthalmologists assigned to evacuation hospitals were not completely occupied with duites of their specialty, this was true only because the hospitals were not provided with refraction equipment and was not caused by lack of need for a full-time ophthalmologist.

Station hospitals were in less urgent need of highly trained ophthalmologists, and none were assigned to them. In those hospitals, eye casualties who needed expert care could easily be evacuated to general hospitals which normally were within consultation range. However, it was noted during the survey that there was often unnecessary delay in moving such patients.

The fact that injuries to the eye are always emergencies did not justify the assignment of ophthalmologists to field hospitals. These injuries were not sufficiently frequent to occupy an ophthalmologist so assigned, and his specialized training would have been wasted in the performance of duties for which he was not trained. Ophthalmologists were therefore not assigned as far forward as field hospitals. The ideal solution of this problem would have been that employed by the British. The Royal Army Medical Corps in the Mediterranean theater employed from 6 to 8 mobile ophthalmologic units consisting of an optical and a surgical van, with an ophthalmologist and other personnel assigned to each unit. For housekeeping purposes, these units were attached to casualty clearing stations, but they were deployed as action demanded, doing refractions and performing operations according to the special needs of the moment. The scheme was practical because the British Army, in contrast to the United States Army, was assigned a full-time consultant in

ophthalmology who could keep constantly abreast of the ophthalmologic needs of the whole theater.

After the survey made early in 1944, ophthalmologic personnel in the theater were generally redistributed in line with the policies outlined, and specialized centers for the treatment of diseases and injuries of the eye were set up. As a result, when the situation was again surveyed in the first 3 months of 1945, the distribution of ophthalmologic personnel was found to be as satisfactory as possible under the Army plan of having at least one ophthalmologist located in every general and evacuation hospital and one in every station hospital of 500 beds or more. Naturally, not enough ophthalmologists certified by the American Board of Ophthalmology, or men of equivalent training, were available in the theater to supply the demand in full, nor could such a supply ever be anticipated. At this time, however, general hospitals were adequately staffed with highly trained ophthalmologists. Evacuation hospitals were also adequately staffed with a single exception; in that installation, an experienced ophthalmologist had been evacuated to the Zone of Interior because of illness. His work was being carried by the otolaryngologist. Three station hospitals had no regularly assigned ophthalmologists, but one of these hospitals was in the process of staging, and the others were staffed with ophthalmologists on temporary duty.

In spite of the improvement in the situation, there was still some wastage of trained personnel in the theater at the time of the 1945 survey. Two ophthalmologists certified by the American Board of Ophthalmology were assigned to nonmedical units of the Fifth U. S. Army in accordance with the policy of giving all recently arrived medical officers 6 months of field training before assigning them to hospitals. Numerous ophthalmologists assigned to Army Air Force units were also doing little or no work in their specialty.

OPHTHALMIC CENTERS

The first ophthalmologic survey, in 1944, made it clear that, in the Mediterranean Theater of Operations, there were not enough highly trained and widely experienced ophthalmologists to provide the highest quality of care for ophthalmologic casualties in all hospitals. The solution to the problem, therefore, was a concentration of these casualties in hospitals staffed with specialized personnel and designated as specialized centers. It was recommended that these centers be established for the following reasons:

1. Better care would be available to a greater number of eye casualties because surgical specialists would be fully engaged in the field for which they were trained and scarce items of equipment, including giant magnets and slit lamps already requisitioned from the Zone of Interior (p. 54), would be available for use by a greater number of ophthalmologists.

2. More efficient utilization of medical personnel could be accomplished. At the time of the survey, no hospital in the four base sections of the Mediter-

ranean theater was receiving as much eye work as it could handle. Only the 33d and 37th General Hospitals were near saturation, and, if optometric personnel had been supplied to assist with refractions in these hospitals, much greater loads could have been handled in them. The designation of special hospitals as eye centers in a group of installations in close proximity to each other would liberate 8 to 10 ophthalmologists for assignment elsewhere, particularly to the newly designated eye centers and to evacuation hospitals then without these specialists.

3. The supply of glass artificial eyes could be handled more efficiently. Considerable saving in transportation would be made possible by concentrating the supplies of artificial eyes in eye centers where casualties and other individuals in need of prostheses would be hospitalized.

4. Better records could be kept. Ophthalmologic records, at the time of the January 1944 survey, were of little or no value from either the military or the medical standpoint.

5. Ophthalmologic teaching would be practical. Young ophthalmologists who had had adequate training but who were lacking in practical experience could be attached to the centers in junior positions. Later, when placed on their own responsibility in station hospitals, they would be far more useful because of their period of service with more experienced ophthalmologists.

6. Psychotherapy and occupational therapy, an essential part of early treatment for the blind and visually handicapped, could be best employed in eye centers. Moreover, early participation in community life with similarly handicapped individuals was recognized as extremely desirable for newly blinded men. Even after an active program for blinded casualties had been organized in the Zone of Interior, there was still a valid need for centers in overseas theaters since, at the best, several weeks usually elapsed before they could be returned to the Zone of Interior.

It was estimated that one competent ophthalmologist, assisted by a less thoroughly trained medical officer, could easily care for 50 to 75 hospitalized patients and, at the same time, be responsible for the outpatient work of a single center. On this basis, from 7 to 10 centers (approximately 1 center for every 2 general hospitals in the theater) could easily handle the estimated number of ophthalmologic patients then in the theater. Since at the time of the 1944 survey there was a highly experienced ophthalmologist in each base section, it was suggested that the specialized centers be located in the following hospitals: The 46th General Hospital at Assi Bou Nif in Oran, the 21st General Hospital at Bagnoli, the 26th General Hospital at Bari, the 3d General Hospital at Mateur, the 17th General Hospital at Naples, the 64th General Hospital at Maddaloni, and the 6th General Hospital at Casablanca. Eye centers were eventually established at all of these installations.

The wisdom of the proposal to establish eye centers was clearly evident from the situation prevailing in the hospital group at Assi Bou Nif in Oran at the time of the 1944 survey. Exclusive of the 51st Station Hospital, which was

receiving only neuropsychiatric patients, there were in the five other hospitals in the area (the 43d, 46th, and 70th General Hospitals, and the 23d and 69th Station Hospitals) only 33 listed eye patients, while the average daily number of outpatient visits varied from 8 to 13. Obviously, the ophthalmologists' specialized training was far from fully utilized at these hospitals, since their time was not fully occupied with duties pertaining to their specialty. Investigation of other hospitals produced somewhat similar findings.

The ophthalmologic survey made a year later, in February 1945, revealed that ophthalmologic personnel were at that time distributed in the theater as well as could be expected and also indicated that the six ophthalmologic centers which had been established had fully served their purpose. They had provided competent care for the largest possible number of patients at a time when the most capable ophthalmologists and the best equipment were not equally dispersed in the theater. General hospitals were now well staffed and equipped (p. 51), personnel in the theater had gained experience and knowledge, and the best methods of treating patients with diseases and injuries of the eye were well understood. It was thought that continued operation of the specialized eye centers was no longer needed, but the recommendation that the centers be discontinued as such was anticipated by the ending of fighting in the Mediterranean theater.

EQUIPMENT AND DRUGS

At the time of the ophthalmologic survey in 1944, there were several major deficiencies in the ophthalmologic equipment in the Mediterranean theater. Some items were unsatisfactory, some were in excess, and others were in short supply. By the end of the war, most of the deficiencies in major equipment had been corrected, and the equipment that had been received was of excellent quality. The supply of instruments was, however, still unsatisfactory in many respects. The supply of drugs, which originally had been unsatisfactory in several aspects, was entirely adequate by the end of the war.

Equipment

Slit lamps.— At the time of the survey in January and February of 1944, there was no slit lamp in any hospital in the Mediterranean theater, although this instrument is as necessary to the ophthalmologist as the microscope is to the pathologist. Without a slit lamp, accurate diagnosis and adequate treatment are not possible. The high cost of this item (several hundred dollars) and the relatively small number of eye cases did not warrant the installation of a slit lamp in each hospital, and the solution was the judicious placement of a limited number in strategically located hospitals in forward and rear areas. It was recommended that six lamps be ordered at once and distributed according to this plan. At the end of the war, five general hospitals still were not equipped, but otherwise the supply of slit lamps was adequate and the quality excellent.

Giant magnets. The 1944 survey disclosed that there were no giant magnets in any hospital in the Mediterranean theater, and the extraction of small and only slightly magnetic intraocular foreign bodies was consequently handicapped (p. 51). It was recommended that four of these magnets be requisitioned at once for distribution to strategically located hospitals. At the end of the war, 8 general hospitals still were not provided with giant magnets, and 1 evacuation hospital and 3 station hospitals still had no hand magnets, although the supply of small magnets had been generally adequate from the beginning of the war.

Tonometers.—Tonometers were not in adequate supply in the winter of 1944. Mild cases of glaucoma were therefore being diagnosed entirely by the clinical picture and by palpation, although the diagnosis of this condition cannot be confirmed without a tonometer and treatment without it is tentative. By the end of the war, the supply of tonometers in eye centers and general hospitals was adequate.

Perimeters.—Neither of the perimeters listed in the Medical Department Supply Catalog was available in the Mediterranean theater at the time of the 1944 survey. It is true that 90 percent of the information concerning visual fields supplied by this peice of equipment can be gained from a tangent screen easily constructed by framing a blanket. This and other ingenious improvisations were used in various hospitals. Certain information supplied by the perimeter, however, cannot be obtained otherwise, and it is a necessary item in every complete eye department. The supply was generally adequate by the end of the war.

Ophthalmoscopes.—The quality of the ophthalmoscopes provided in the cases of diagnostic equipment issued by the Army varied with different makes and models. To be satisfactory, it was necessary that an ophthalmoscope furnish good illumination and that the expendable parts (bulbs and batteries) be easily replaced.

Adaptometers.—Adaptometers did not reach the theater until March 1945, when 10 Feldman adaptometers were distributed to general hospitals. This instrument was not so useful as the Wilson adaptometer used by the British, which was not available in the United States. It was recommended that procurement of Feldman adaptometers be discontinued.

Refraction equipment.—The case of trial lenses for refraction contained more than the necessary number of lenses. It was suggested that a less complete and less costly case be substituted for this item and that a greater number be authorized.

In January 1944, the distribution of available trial-lens cases was poor. No evacuation hospital in the theater had a case, while the 7th Medical Supply Depot had seven cases which were not being used. The 36th General Hospital, which had 4 competent refractionists, had only 1 trial-lens case. At this hospital, which was 20 miles nearer the front than any other general hospital, appointments for refractions were being made 6 weeks in advance. Provision

of one or more additional cases would have doubled or tripled the number of refractions which could be done.

There was general criticism that the trial frame supplied with the trial cases was of flimsy construction and lacked adjusting mechanism. The comments were warranted, but the frame was inexpensive and there seemed to be no justification for recommending the substitution of a frame which would have cost considerably more.

Cross cylinders, which are invaluable adjuncts to good refraction, were neither available in the theater nor listed in the Medical Department Supply Catalog. Some refractionists had solved this deficiency by mounting combined lenses from the trial case. It was recommended that cross cylinders be supplied in sets of 3 to each trial case (plus 0.25, plus 0.50, plus 1.00 cylinder).

The type of astigmatic dial supplied in the theater was of almost no use because the secondary adjustable or rotating dial was not included with it. It was recommended that the Verhoeff or Lancaster type be supplied.

A larger assortment of vision-test cards was needed to make visual testing and refraction more accurate in subjects with good visual memories. In January 1944, only two alternate charts were available in the vision-test set. It would have been desirable to have available the rotating series of four charts (made by Hamblin, London) used in British hospitals. These charts, mounted on a revolving 4-sided column, were well illuminated and could easily be disassembled and packed into a small case.

Stereoscopes for testing depth perception, which is an essential procedure in any complete eye examination, were lacking. It was recommended that the simple hand type with appropriate cards be made available.

Surgical instruments.—At the conclusion of the first ophthalmologic survey in the Mediterranean theater, it was recommended that the entire surgical armamentarium be reviewed for the following reasons:

1. Some instruments were in excess. The large numbers of cataract knives and canaliculus knives provided, for instance, were not needed. Cataract surgery was only occasionally necessary in the military age group, and the slitting operation (for stenosis of the canaliculus) was very seldom done. It was recommended that the supply of both instruments be greatly reduced and that iris scissors, which were in short supply, be substituted for them.

2. There was a deficiency (either in supply or in the Medical Department Supply Catalog) of such instruments as capsule forceps for performing anterior capsulectomy of the lens in linear cataract operations, Prince forceps for grasping the extraocular muscles, and retinal detachment instruments such as Arruga retractors and Walker pins. As late as May 1945, only two evacuation hospitals had equipment for the treatment of retinal detachment.

3. It was recommended that certain of the instruments supplied either be simplified or be replaced with better models. A small-sized chalazion curette, for instance, was needed in addition to the medium-sized instruments. The smaller of the chalazion forceps was useless for large lesions. The discission

knife furnished was much too coarse and rough to carry out discission for secondary cataract. The eye speculum was of poor design and quality; the lips did not protect the cilia, and the design did not permit digital support during operation.

Not many of the recommended changes in the design or supply of instruments had been carried out by May 1945, and the instrument situation in the theater, from an ophthalmologic viewpoint, was still regarded as generally unsatisfactory.

Drugs

Ophthalmologic medications, which consist essentially of collyria and ointments, form a highly specialized group of pharmaceuticals which cannot be satisfactorily prepared in the average hospital pharmacy. Supply channels in the Mediterranean theater took no account of these facts.

During the early part of the North African campaign, many drugs essential for ophthalmologic treatment were lacking. Notable deficiencies were as follows:

1. Atropine sulfate in 1-percent solution, which is widely used and which had to be prepared by dissolving hypodermic tablets of 0.65 mg. each;

2. Atropine ointment, which was still not available in January 1944;

3. Eserine (physostigmine) and pilocarpine, which are essential miotics in the treatment of glaucoma and are also useful in contusions, and one of which, pilocarpine, did not become available until late in 1943;

4. Sulfonamide ointments, especially sulfathiazole ointment, which must be specially prepared for use in ophthalmology; and

5. Boric acid ointment, a special ophthalmic preparation, the lack of which caused some ophthalmologists to substitute butyn and metaphen ointments. Many ophthalmologists believe that these latter preparations did more harm than good, and their impressions were borne out by the number of patients seen with progressive and intractable corneal ulceration during their use. When the ointments were discontinued, the ulcerations invariably healed promptly. An attempt was made to alert the medical officers in the theater to the dangers involved in the the continued application of Butyn and Metaphen preparations, with the result that the number of corneal complications caused by their use soon showed a gratifying drop.

All the deficiencies mentioned were gradually corrected, and by May 1945 the supply of drugs was adequate, and the preparations were satisfactory.

THE OPTICAL PROGRAM

Spectacles

When the first ophthalmologic survey was carried out in the Mediterranean theater, supply problems concerned with the provision of glasses were numerous.

Soldiers had been evacuated from the theater to the Zone of Interior

because glasses could not be supplied to them in the theater. This was an unnecessary waste of manpower. Thirty-six men had been evacuated for this reason alone from the 6th General Hospital over an 11-month period, and in other installations the number was even larger.

There were long delays in furnishing glasses after refraction. In one medical-supply depot, the shortest period was 11 days, while delays up to 50 days had occurred when minus 8.00 spheres were needed. The longer periods were attributed to lack of supplies, chiefly blank lenses, and to delays in grinding. Savings amounting to as much as 3 days were achieved when prescriptions could be delivered and retrieved directly by messenger and the delays of postal and courier service could be avoided.

Supplies of various kinds were frequently lacking in optical sections. In one section, the alarming shortages of coarse emery threatened to force total discontinuance of surface grinding. The installation of surfacing spindles later corrected this particular difficulty.

The supply of lenses was not adequate to the needs. This difficulty arose because of lack of correlation between induction standards of vision and the practical correction of visual defects. Mobilization regulations were based on visual acuity which is a variable factor and which is considerably altered by the effort exerted, squinting, the degree of illumination available, and similar factors. The correction of visual defects in the summer of 1943 had apparently been based on a foci range which would be expected to correct defective vision if the eyes were treated as a static camera. At one time, when men were being inducted with visual defects of 20/200, minus 4.00 was the strongest minus sphere supplied, and the quantity available was so limited that by July 1943 the strongest minus sphere available was minus 3.00. Soldiers who required stronger corrections could not be supplied, and some had to be evacuated to the Zone of Interior for this reason alone.

The quality of the frames varied considerably, since they were supplied by several different companies. Some frames were irregular and bent easily. In others, the screws broke readily. Still others tarnished and caused skin infections about the temples.

Only one pair of glasses was authorized for each soldier. All prescriptions issued had to be over 1.00 diopters in power in the meridian of greatest error. Lenses such as plus 0.75 sphere combined with plus 0.50 cylinder were above the minimum, while lenses of minus 1.00 sphere were below. Lenses of lesser power could be ordered but only if the medical officer signed a statement that they were necessary for the proper performance of duty by the soldier.

At the time of the survey in 1944, smoked or colored glasses for patients with photophobia from ocular inflammation were not available in the theater. It was recommended that an ample supply of inexpensive glasses be requisitioned to meet this need. This recommendation was carried out.

Eye patches supplied for use in the theater were not satisfactory. One type, made of celluloid with an elastic band, prevented circulation, was im-

pervious to air, and caused maceration of the skin. The other type, an eyeshade such as is used by bookkeepers, was practically useless.

The supply and strategic distribution of portable optical units [2] improved the situation in respect to the supply of glasses, but these units did not prove as useful as they should have been because they were not used for the purposes for which they were designed. They were never integrated into an organization of mobile refracting teams to serve forward units. There were also some deficiencies in equipment. The edging wheel was hand operated and therefore impractical and wasteful. In addition, the stock of lenses was small and not selected according to the needs of spectacle-wearing soldiers who were completely dependent on their glasses.

Glasses for Gas Masks [3]

The supply of glasses for gas masks was a theoretical problem throughout the war. At the time of the January February 1944 ophthalmologic survey in the Mediterranean theater, no active steps had been taken to distribute them in that theater. This was just as well, since an examination of the foci range of the lenses held for this purpose at two medical-supply depots showed them to be based on the Army assortment for ordinary spectacle distribution and not on a selection for a group of individuals with unusually poor visual acuity. It was calculated that not more than 22 percent of the stock available in these depots could be used for gas-mask spectacles.

The probable number of gas-mask lenses required for issue in the Mediterranean theater was determined by screening the 88th Division when it was encamped in the Mediterranean Base Sector. The procedure was to test the uncorrected binocular vision of each soldier who wore spectacles and to list those who could not read (with squinting) the 20/70 line of the Snelling test chart. Of the 15 percent of men who wore glasses, not quite 3 percent had worse than 20/70 binocular vision and, by Army regulations, required gas-mask lenses. In order to estimate from the prescriptions which soldiers wearing spectacles would require gas-mask spectacles, an arbitrary correlation was drawn between 20/70 binocular visual acuity (with squinting) and the strength of the lens necessary to correct vision fully. Ametropias and corresponding correcting lenses were as follows:

1. Myopia: Minus 3.00 sphere or stronger.
2. Hyperopia: Plus 4.00 sphere or stronger.
3. Simple astigmatism: Plus or minus 3.00 cylinder or stronger.
4. Compound or mixed astigmatism: Where the combined spherocylinder was plus or minus 3.00 cylinder or more in the greatest meridian.

On the basis of the findings in the 88th Division, it was estimated that

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[2] Circular Letter No. 45, Office of the Surgeon, Headquarters North African Theater of Operations, 25 Nov. 1943, subject: *Procedure for the Operation of Mobile, Base, and Portable Optical Repair Units.*

[3] Report, Maj. Trygve Gundersen, MC, to Surgeon, Services of Supply, North African Theater of Operations, 9 Sept. 1944, subject: Supply and Distribution of Spectacles, Gas Mask-M1, Stocks of Which Have Arrived in This Theater.

30,000 pairs of gas-mask spectacles would be required for every 1,000,000 men in service. There were in the Mediterranean theater at the time of the January-February 1944 ophthalmologic survey 12 gas-mask fitting cases containing this number of lenses and frames, as well as 7 portable units. The foci range, however, as has already been noted, did not meet the needs. A further difficulty arose from the fact that, if the fitting of the lenses was not accurate, vision would be made worse, especially in astigmatic subjects. Fitting would therefore require the services of experienced opticians, who had had special instructions and had developed special facility in the work, and each fitting would have to be made individually.

It was estimated that each optician could, at the best, fit only 5 or 6 pairs of gas-mask spectacles per hour, and that 2 working together, with a ready supply of patients, could fit 80 pairs daily; that is, they could service 2,666 troops.[4] For every two opticians working in the Army area, an ophthalmologist would be required to supervise the work, give special instructions, refract the eyes of soldiers who had lost their glasses, and re-refract the eyes of others whose glasses were not satisfactory.

The following plan was worked out:

1. An ophthalmologist would be put on temporary duty to instruct other personnel and correlate and supervise the whole task of fitting gas-mask spectacles in the Mediterranean theater.

2. Fitting cases would be distributed to hospitals in the theater on the basis of troop concentrations.

3. The Snelling vision-test cards would be used by medical officers of each division to screen spectacle wearers.

4. Men with uncorrected binocular vision of 20/70 (with both eyes open and squinting) would be sent, with their gas masks, to the nearest hospital for examination and, if necessary, refraction. Prescriptions for lenses would be delivered to the nearest mobile optical units, and the completed gas masks and spectacles would be mailed to the wearers. The lenses would be placed and inspected by the unit medical officers. Whenever the results were not satisfactory to the wearer and the inspecting officer, the soldier would be sent back to the hospital for special adjustments.

5. This service would be provided for the army areas by 6 portable units, to each of which 1 ophthalmologist and 2 opticians would be attached as mobile teams. One such unit would be assigned to each corps surgeon.

In spite of these elaborate plans, only 2 pairs of gas-mask spectacles had been fitted up to May 1945—1 by the 26th General Hospital and 1 by the 7th Station Hospital.

It was not generally realized, when these plans were made, that not every person who wore glasses would need gas-mask spectacles. By the original plans, everybody who wore spectacles would automatically be given gas-mask spectacles. Practically, this was entirely unnecessary; only men with the

[4] See footnote 3, p. 58.

worst vision, who would be helpless without glasses, actually needed them. Moreover, while the ideal of the planning was to render spectacle-wearing men completely efficient during gas attacks, from the practical standpoint this was an ideal impossible of achievement.

Prostheses

The survey made in January and February of 1944 revealed that glass eyes were not available in the Mediterranean theater. This deficiency made it impossible to supply prostheses for personnel whose eyes had been enucleated or who had been inducted with only one eye. As a result, an important part of the routine of management of men with enucleated eyes had to be omitted, while in several instances it was necessary to evacuate soldiers to the Zone of Interior because they had broken their prostheses. Seven perfectly healthy men were evacuated for this reason from the 6th General Hospital alone.

To correct this deficiency, it was recommended that 3,000 artificial glass eyes be requisitioned at once for use in the theater, the supply to be divided equally between two general hospitals to be designated by the theater surgeon.

In a few instances, glass eyes were secured locally. The making of these eyes is a highly specialized trade in certain civilian families in Italy, the secret of manufacture being guarded carefully and passed on from generation to generation. The price was remarkably low. Many artificial glass eyes were fitted for as little as $2.50 per eye. Some plastic eyes were made, but colored acrylics were lacking, and the number was small. The plastic-eye program in existence in the European theater was called to the attention of the Surgeon, Mediterranean Theater of Operations, late in March 1945,[5] but because the war ended so soon afterward, as well as for other reasons, no similar program was instituted in the Mediterranean theater.

By May 1945, 3,349 glass eyes had been issued to hospitals in the Mediterranean theater, and 79 had been purchased locally; 204 of the former and 70 of the latter had been fitted, the fittings being considered satisfactory in 132 of the 274 cases.

THE REFRACTION PROBLEM[6]

The magnitude of the refraction problem in World War II can be appreciated by recollection of the fact that, in the early months of the war, about

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[5] (1) Letter, Col. Robert J. Carpenter, MC, to Commanding General, United States Army Forces, Mediterranean Theater of Operations (Attn: The Surgeon), 24 Mar. 1945, subject: Fabrication of Acrylic Eye Prosthesis. (2) Letter, Maj. Trygve Gundersen, MC, to Col. Earle Standlee, MC, 10 Apr. 1945, subject: Acrylic Eye Prosthesis.

[6] (1) Report, Maj. William H. Droegemueller, MC, and Capt. Edmund F. Alvis, MC, to Surgeon, Fifth Army, 12 Mar. 1944, subject: Report of Findings of II Corps Eye Clinic. (2) Report, Maj. W. H. Droegemueller and Capt. E. B. Alvis, to Surgeon, Fifth Army, 28 Mar. 1944, subject: Final Report of II Corps Eye Clinic. (3) Report, Maj. W. H. Droegemueller and Capt. E. B. Alvis, to Lieutenant Colonel Bruce, MC, Office of the Surgeon, Fifth Army, 6 May 1944, subject: Report of Fifth Army Refraction Clinic. (4) Report, Capt. Charles H. Behnke, MC, to Maj. Trygve Gundersen, MC, 6th General Hospital, 13 Feb. 1945, subject: Report of Equipment and Professional Service of II Corps Eye Clinic.

15 percent of Army personnel wore glasses and that this figure rose progressively as the war continued and as visual standards for induction were reduced. A well-organized and efficient refracting service would have been necessary for this reason alone, but other valid reasons for its establishment also existed:

1. The maintenance factor for Army spectacles in the Mediterranean Theater of Operations was estimated at 30 percent per month, and glasses worn by each spectacle-wearing member of the Armed Forces had to be replaced every 3 or 4 months. These are far higher figures than prevail in civilian life. They are to be explained partly by a lack of any sense of responsibility for property not provided personally and partly by such legitimate reasons as the abnormal wear and tear of military life, combat, combat training, unusually strenuous games, and other causes which are not common in civilian life.

2. Re-refraction was necessary in a very large number of cases because prescriptions for the glasses worn by Army personnel were not available to the ophthalmologist. The majority of Army personnel, whether officers or enlisted men, did not have their prescriptions with them when they appeared for refraction or with their glasses broken, and many otherwise unnecessary refractions had to be carried out for this reason. This situation prevailed in spite of the fact that prescriptions for officers were supposed to appear on their immunization registers and prescriptions for enlisted men on their service records. A check of eight groups of patients who entered the 6th General Hospital between 5 December 1943 and 4 March 1944 showed that, of the total of 3,477, almost 43 percent did not have their service records with them. The proportions in the individual groups ranged from a low of 37 percent to a high of 79 percent.

The problem of refraction differs in Army and civilian practice. In the Army, the chief concern is to correct impaired visual acuity. Asthenopias caused by small refractive errors are left untreated, except in occasional instances. It was found, in the Mediterranean theater, that it was best not to prescribe glasses and also best to remove them, if they were being worn, when the refractive errors did not justify the symptoms complained of. There was good reason for this practice. Unless glasses positively improved his visual acuity, a soldier who had to face all kinds of weather conditions and many types of hazard could perform his duties more efficiently without glasses and was spared the risk, observed in many casualties, of being injured by the shattering of his lenses.

An additional refractive problem which was encountered in hospitals located in or near replacement areas was that of classifying soldiers and determining whether they should be assigned to field or limited service. This was time-consuming work, since all pathologic processes and all evidence of malingering had to be carefully ruled out before the decision was made.

Personnel

Although in civilian life most glasses are fitted by optometrists or other nonmedical refractionists, the Army required medical officers to do this work. The burden on the ophthalmologist was therefore enormous. He either spent the major portion of his time refracting, or he had to train an enlisted man to assist him in taking visual acuities, neutralizing lenses, fitting spectacle frames, and carrying out associated time-consuming procedures which were not strictly medical. He was not using his special training and ability to the best advantage when he had to occupy himself for many hours of the day in refractions and the fitting of glasses.

At the time of the January–February 1944 survey, optometrists as such had no place in the tables of organization of Army hospitals, and, although numerous men trained in this field were in the theater, they were assigned to other branches of service. At the 37th General Hospital, for instance, an unusually well-trained optometrist was working in the laboratory. A similarly well-trained man was working in the mobile optical unit attached to the 12th Medical Supply Depot Company. Numerous other instances of the same sort were encountered.

The situation in regard to refractions at the 6th General Hospital in the North African theater had been greatly simplified by the discovery of a well-qualified optometrist among the detachment personnel. He was promptly assigned to the duties for which he had been trained, and a routine was devised in which his abilities were used to the fullest. Every soldier who entered the eye clinic with the idea that he needed glasses first saw this optometrist, who took a full history and, if it was indicated, made a manifest refraction. If homatropine refraction seemed necessary, the medical officer was consulted, and it was carried out if he agreed that it was required. Only after these data were secured did the patient see the ophthalmologist, who then, without loss of time, completed the medical phase of the examination, checked the refraction, prescribed glasses, or otherwise completed the disposition of the case. The possession of two trial-lens cases at this hospital greatly facilitated the operation of this plan; the optometrist was able to perform up to 331 refractions per month, while, at the same time, the ophthalmologist was free for strictly medical duties.

It was estimated by the officers who made the ophthalmologic survey in 1944 that if such a plan as that in operation at the 6th General Hospital could be put into effect in other hospitals, an experienced ophthalmologist, relieved of the bulk of the refraction routine, could readily carry the medical and surgical care of the ophthalmologic services of 2 general hospitals of 1,000 beds each in the North African theater.

The difficulty lay in finding the optometrists. This category of inductees had not been given a machine records unit number until 15 September 1943, which was after the induction date of most men in the theater in January 1944.

It was suggested, therefore, that notices should be placed on detachment bulletin boards inquiring for optometrists who wished to do optometry. This plan was carried out, and, by these and similar methods, a pool of trained men was promptly secured.

In addition to the burden placed on the ophthalmologist by the failure to use optometrists in their field of training, a lack of refracting facilities in the North African theater accounted for the hospitalization and, often, the evacuation of perfectly healthy men for the sole purpose of securing spectacles. In the Fifth Army zone of combat in Italy, evacuation was often as far back as Naples and from 3 to 14 days might elapse before the soldier again rejoined his unit. Divisions engaged in combat had accumulations of several hundred soldiers awaiting refraction. Numerous men were being evacuated from the Anzio beachhead to Naples as long as 2 months after debarkation day merely for refraction and for the replacement of glasses. A check of the 52d Station Hospital on 20 February 1944 showed that of 700 admissions for all causes on that date, 25 (3.6 percent) were solely for refraction.

Equipment

The situation, with its loss of manpower at a time when manpower was desperately needed for strictly military purposes, could not be met otherwise than by the methods employed because the tables of equipment for evacuation *and convalescent hospitals did* not include trial-lens cases and vision-test charts (p. 54). During the Tunisian campaign, for instance, only 2 evacuation hospitals, the 9th and the 15th, were able to accept any patients for refraction (and those only during relatively inactive periods) because they were the only hospitals in the theater which had been issued trial-lens cases. Actually, they had them only on memorandum receipt, since they were not part of the equipment of an evacuation hospital. During the early phases of the Italian campaign, because of the same lack of equipment, only the 15th Evacuation Hospital could perform refractions for the Fifth Army.

As late as May 1945, the situation in respect to refraction equipment was still not entirely corrected. Only one evacuation hospital, which had done 1,800 refractions, had a regular trial case. Pocket-sized trial cases had been given to 3 station hospitals and 1 evacuation hospital and from 1,447 to 3,000 refractions had been done with them. No other forward hospital had any equipment of any sort for refractions.

Establishment of Refraction Teams

To correct the refraction situation in the Fifth Army zone of combat, it was recommended by the acting consultant in ophthalmology, on the basis of his survey of the theater, that two ophthalmologists be assigned for as long as necessary to the Fifth Army, to locations to be designated by the Army

surgeon, to perform the accumulated refractions. It was further recommended that each ophthalmologist be furnished with the necessary equipment for refraction and be supplied with an enlisted technician.

In accordance with this recommendation, two properly equipped refraction teams were duly organized and were attached to the 54th Medical Battalion on 7 February 1944. Between 19 February and 1 March, it was possible for this unit to function only 5 days, but during this activity, in 3 different locations, it had carried out 251 refractions and prescribed 70 pairs of glasses. Approximately half of the men whose eyes were refracted had been seen by a military ophthalmologist for the first time since their induction. It was estimated that 2 months more would be required to care for the accumulated refractions in two divisions then in adjacent rest areas.

Statistical Data

An analysis, 1 May 1945, of the refraction material in the Mediterranean theater for all the hospitals, exclusive of those which had left with the Seventh Army in 1944, revealed the following data:

1. In 11 general hospitals operating refraction clinics for periods ranging from 13 to 20 months, 23,802 refractions had been performed and 11,256 pairs of glasses prescribed. Of the refractions, 36.5 percent had been done by optometrists.

2. In seven evacuation hospitals operating refraction clinics for periods ranging from 3 to 32 months, 7,974 refractions had been performed and 4,204 pairs of glasses prescribed. Of the work, 50.7 percent had been done by optometrists.

3. In 23 station hospitals operating refraction clinics for periods ranging from 14 to 26 months, 33,868 refractions had been performed and 21,026 pairs of glasses prescribed. Of the work, 42 percent had been done by optometrists.

4. In one convalescent hospital operating a refraction clinic for 17 months, 1,697 refractions had been performed and 1,124 pairs of glasses prescribed. All the work had been done by ophthalmologists.

5. In the whole theater, 69,141 refractions had been performed and 38,510 pairs of glasses prescribed. Of the work, 72 percent had been done by ophthalmologists, 26 percent by optometrists, and 2 percent by other personnel.

Refraction Problems on the Anzio Beachhead

As an outgrowth of the refraction facilities set up for the Fifth Army, a refraction unit operating with the II Corps was established on the Anzio beachhead to provide this corps and attached troops with refraction service and to repair and replace glasses. Maj. William H. Droegemueller, MC, of the 12th General Hospital, and Capt. Edmund B. Alvis, MC, of the 21st General Hospital, who were in charge of the refraction unit on the Anzio beach-

head, made the following report to the Surgeon, Fifth Army, 12 March 1944:[7]

The unit consisted of 2 ophthalmologists, 2 technically trained enlisted men, and 1 clerk. The clinic was set up in a ward tent, with equipment for 2 complete refraction ranges and a waiting room for approximately 30 patients.

The maximum theoretical capacity of the clinic was 70 patients daily. The number usually included 60 new patients and 10 returning patients. Although an effort was always made to complete the examination in a single visit, this was not always possible. In 45 percent of the cases, cycloplegia was necessary, in many instances after preliminary manifest refraction. Moreover, movement of the clinic from one location to another, difficulty in making and keeping appointments, and the necessity of leaving time open for small units without appointments frequently reduced the number of patients seen daily to below the theoretical capacity.

Glasses were distributed directly from the supply depot to the patient, usually within 5 days. The attempt to distribute glasses from the clinic was found impractical because of the difficulty in having men return for this purpose and because their return interfered with maximum function of the clinic. The service of adjusting frames and checking lenses was offered but was seldom used because it was often not feasible.

At the conclusion of examination and treatment, the following form indicated to the medical officer of the patient's unit what had been done, together with the diagnosis and recommendations, and supplied the information which, according to Army regulations, was to appear on the patient's service record:

II CORPS EYE CLINIC

To: Surgeon _____ Date _____
Report: Eye Examination _____
O. D. 20/ Corrected Vision 20/ by ____ s. _____ cyl. axis _____
O. S. 20/ 20/ ____ s. _____ cyl. axis _____
Frame Measurements P. D. _____ Br. _____ Eye Size _____ Temple _____
Please record the above data on EM's service record.

Findings: Cycloplegia used yes ( ) no ( )

Glasses ( ) are not necessary.
( ) have been ordered from _____ Med Supply Depot.
( ) prescription has been changed and glasses ordered.
( ) Prescription has not been changed, new glasses were ordered.
( ) EM has are adequate and do not need changing.
( ) are advisable but not authorized under existing regulations, unless certified as necessary by the unit commander.

Symptoms of _____ are not in our opinion of ocular origin.
Comments, Recommendations or Pathology noted. _____

The supply of glasses ordered will be direct from the _____ Med Supply Depot.
For adjustment of frames or problems in wearing of the glasses refer to this clinic.

[7] See footnote 6 (1), p. 60.

The second report from the eye clinic on 28 March 1944 to the Surgeon, Fifth Army,[8] indicated that the provision of glasses, after refraction, had become a major problem. The chief reasons for the difficulties encountered were (1) the separation of the refraction center and the supply center; (2) an insufficient stock of medium-strength lenses; and (3) the presence in forward units of men with high errors of refraction, the correction of which required surface-grinding equipment. At first, rapid supply was accomplished by the mobile optical unit attached to the 12th Medical Supply Depot. This unit, however, could not furnish high corrections. Prescriptions for these lenses (and, later, all prescriptions) were sent to the optical unit attached to the 4th Medical Supply Depot. As of 28 March, none of the high corrections ordered had yet been delivered because of lack of proper lens blanks. The delay in some cases had amounted to 6 weeks. The 4th Medical Supply Depot at this time had run out of regular stock, and 48 prescriptions had been sent to the 12th Medical Supply Depot which could not, it was thought, fill most of them. The delay introduced between the refraction of the soldier's eyes and the actual delivery of the glasses was a serious matter for him, particularly if he wore a high correction, and it usually meant lost labor on the part of the ophthalmologic personnel, since a certain number of glasses never got to their proper destination.

The 615 refractions completed on the Anzio beachhead by 12 March 1944 were analyzed as follows in the report[9] made on that date:

Approximately 65 percent of the men who came to the clinic for refraction were without glasses; 22.8 percent of the total number either had had glasses and had lost them or had been tested for Government-issue glasses but had never received them. The length of time they had been without glasses ranged from a month or less to more than a year; in the majority of cases, it varied between 1 and 6 months. Perhaps a third of the men without glasses were definitely handicapped by not having them. There were several reasons for their being without them; chiefly, changes of location and personnel, prescriptions for high corrections which could not be furnished in the theater, and lack of the prescriptions for glasses previously worn. Out of all the patients seen in the clinic who wore glasses, less than a dozen appeared with any record of previous refractions; had these prescriptions been available, as Army regulations required, they could have been sent directly to a mobile optical unit, and the wearers need not have appeared at a refraction clinic unless there was some good reason for checking the refraction.

Four percent of the total number of patients seen in the refraction clinic had not previously had their eyes examined. They were given prescriptions for glasses because of moderate errors of refraction with blurred distant vision, headaches of probable ocular origin, and lessened efficiency without glasses.

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[8] See footnote 6 (2), p. 60.

[9] See footnote 6 (1), p. 60.

Of the entire group of patients whose eyes were refracted, 38.2 percent were found not to need glasses. They complained, in the order of frequency, of blurred distant vision, smarting, burning, tearing, poor unilateral vision, and similar symptoms. In all but a small number of cases, these complaints were believed to be sincere. They could readily be explained, however, by unnatural living conditions, poor lighting, blackout driving, antiaircraft observation, and too much time for introspection. The refractions were not regarded as a waste of time; relieving the men of apprehension about the condition of their eyes was of definite morale value. Contrary to expectation, only a few psychoneurotic patients were encountered. A few were chronic repeaters who availed themselves of every opportunity for medical attention and had sometimes been examined five or six times previously. Many of these men had clear-cut disabilities such as amblyopia exanopsia. Others suffered from light sensitivity, and a supply of dark or tinted glasses, which was not available in the theater would readily have taken care of their complaints.

Of the approximately 35 percent of men who came to the refraction clinic already wearing glasses, not quite half (16.4 percent of the total number of patients) had glasses found to be adequate. Some of them were sent in for routine checkup and had no significant complaints. The remainder had a wide variety of complaints such as blackout attacks, night blindness, headaches, sore eyes, tearing, and attacks of dizziness. Complaints that could not be explained on an ocular basis were referred to the unit medical officer for investigation.

Of the total number of patients, 15.3 percent wore glasses which were inadequate and required changing. In some instances, the lenses had to be changed; in others, the lenses or frames were unserviceable or badly fitted. In still other instances, Government-issue glasses were supplied to men who were wearing inadequate civilian glasses.

Of the men examined, 2.9 percent were wearing glasses which were obviously not needed and which were withdrawn. Three-quarters of these glasses had been obtained in the Army.

It was surprising to observe the number of civilian glasses still in use by men with long terms of overseas duty. Government-issue glasses were often uncomfortable when they were first put on and, if the men were not required to wear them but were permitted to continue wearing their civilian glasses, they frequently requested another refraction.

Approximately 11 percent of the patients examined did not meet the requirements of Army regulations for combat troops. The majority were myopic, though many presented amblyopia exanopsia. The presence of men with these conditions in forward areas had much to do with the difficulty of supplying adequate lenses to troops on the Anzio beachhead.

Few instances of actual disease were found in the course of the examinations. There were several instances of congenital cataract and a few congenital anomalies such as coloboma of the choroid. Inactive chorioretinitis was not

infrequent and was often macular. Two patients were recent battle casualties; one of these men had traumatic chorioretinitis with hemorrhage and the other a detachment of the retina which had occurred 2 months earlier.

Night blindness (p. 285) was a frequent complaint, not only in the myopic group but also among those who did not need glasses. In the absence of a visible retinal pathologic process, it was impossible to substantiate this symptom, and, at the time, there was no place in the theater where adequate tests could be made. It could not be determined whether the complaint was an actual medical problem on a nutritional or a psychogenic basis or was simply a normal variant brought out by conditions of military life.

The report on the eye clinic made to the Surgeon, Fifth Army, 28 March 1944 [10] indicated that, up to that time, 1,784 visits had been made to the clinic by 1,628 patients and that 686 pairs of glasses had been ordered. The distribution of cases was substantially the same as in the earlier report, though the proportion of men who, from the standpoint of their eyes, were not combat material had risen to 16 percent of the total number, exclusive of those who, with a high degree of hyperopia and astigmatism, were definitely handicapped without glasses. These two groups constituted about half of the men for whom glasses were ordered. The regulation permitting only a single pair of glasses to a man was a handicap to efficient service by these men, and an attempt was made within the spirit of the regulations to supply them with a substitute pair of civilian glasses, old issue gas-mask glasses, or an inadequate pair of Government-issue glasses. The absence of a mobile unit where frames could be substituted and lenses changed without leaving the man without any glasses at all militated against this endeavor.

In the report to the Surgeon, Fifth Army, dated 6 May 1944,[11] the eye clinic figures for the month ending 5 May 1944 showed that 2,359 visits had been made by 2,208 patients, for whom 935 pairs of glasses had been ordered. The close proximity of the units cared for over this period, as well as promptness on the part of both patients and staff in meeting appointments, made it possible to see from 67 to 104 patients daily, the average being 78.6.

The observations in this report were substantially the same as in the previous reports. In it, however, the officers in charge of the clinic emphasized the educational nature of their work, particularly the necessity of instructing patients in the proper use of glasses and explaining why small errors of refraction do not require glasses, why various corrections are difficult to wear, and why corrections for amblyopic eyes are often not practical. The ophthalmologists were impressed with the indoctrination of enlisted men with civilian commercial ideas concerning the value of glasses, ideas which, they noted, were fostered rather than discredited in the Army. They believed there was need for a guiding directive to medical officers responsible for ordering glasses, making

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[10] See footnote 6 (2), p. 60.
[11] See footnote 6 (3), p. 60.

clear that it was poor policy to give encouragement to the belief that any infirmity existed when it actually did not.

Refraction Problems at a General Hospital

Of the 6,100 individual patients seen in the outpatient clinic of the 6th General Hospital between March 1943 and December 1944, approximately 3,000 required refraction; 2,500 of these were military personnel without eye injuries, for whom 1,374 pairs of glasses were ordered. Two hundred and twelve men were seen because their spectacles were broken and 208 because their glasses were lost, in one-third of the cases, in combat.

Of the men seen in the clinic for refraction, 138 had left the Zone of Interior without glasses, although every soldier who needed glasses was supposed to have received them before he left. In some instances, lack of interest on the part of the wearer was responsible; in other instances, the glasses were simply not received. Ametropia developed in a small group of soldiers during their service overseas.

During the first half of 1943, delivery of spectacles was not entirely satisfactory because of the limited stock of lenses in the optical units. No lenses above plus or minus 3.00 sphere were available and, at the end of 3 months, lenses of over plus or minus 2.50 sphere could not be secured. Plane cylinders could be obtained only as high as plus or minus 2.00 sphere and compounds presented a greater problem. The full prescription was sometimes obtained by using clipons, which carried part of the full prescription. Since spectacles were ordered from the Zone of Interior and 6 to 7 months might elapse before they were received, some such shortcut was necessary.

The situation was corrected in 1944 by the arrival of a larger stock of lenses and by the installation of surface-grinding machines in the optical units. Nearly all prescriptions could then be filled within 2 to 3 weeks. After surface-grinding machines were installed, it was usually possible to obtain cemented bifocal glasses for patients with presbyopia. Thirteen soldiers had been returned to the Zone of Interior from the 6th General Hospital in 1943 because they could not be supplied with glasses in the theater, but none were returned for this reason alone in 1944.

The type of refractive error was distributed as follows: Myopia in 39.4 percent of the cases; hyperopia in 35.4 percent; mixed astigmatism in 15.3 percent; and presbyopia in 4.2 percent. In the remaining cases, no refractive error of significance was found. Many soldiers insisted on their complete dependency on glasses when there was no justification for it in the degree of refractive error found. In 270 of these cases, a diagnosis of ocular psychoneurosis was made, the basis for the diagnosis being the discrepancy between symptoms and physical findings supported by the case history. Thirty-seven soldiers were seen because of hysteria manifested by visual loss; many of these had to be evacuated to the Zone of Interior.

An examination of the records of 1,051 soldiers who had reported to the eye clinic of the 6th General Hospital primarily for refraction and not for primary disease or injury revealed that 693 (66 percent) had a legitimate reason for requesting examination; of these, 493 (47 percent of the total number) were given glasses. In the course of the examination, 16 patients (1.5 percent) were found to have diseases of the eye which were not causing symptoms; 332 (31 percent) were found to have definite psychoneurosis or probable psychoneurosis. The number of patients in the last 2 categories were 191 and 141, respectively. In contrast, psychoneurosis, as related to the eyes, was an extremely uncommon finding in those patients for whom refraction was done on the Anzio beachhead.

RECOMMENDATIONS

The refraction experience in the North African and Mediterranean theater, considering the many difficulties encountered during the first months of fighting and the remarkable improvements accomplished in the later months, suggests the advantages of the following plan in any future conflict:

1. Mobile ophthalmologic teams should be organized promptly to care for accumulated refractions, especially when troops are in rest areas.

2. A regular refracting service should be established for Army areas in such installations as evacuation hospitals.

3. Probably the most economical way of meeting the needs of the situation would be by the establishment in each corps of mobile refraction and optical repair teams, similar to the mobile dental prosthetic teams.

4. Mobile ophthalmologic teams and portable optical units should accompany amphibious landings or should be made available as soon as possible after landings have been accomplished, unless evacuation hospitals are equipped to do refractions. In that case, only portable optical units would need be supplied for amphibious landings.

The experience in the theater suggests the following policies for spectacles and frames:

1. Mobilization regulations should be formulated to specify actual refractive errors as well as visual acuity, as was the practice in the French Army. The foci range in stock lenses could then be planned according to the known refractive errors existing in the Army, and all surfacing of lenses in theaters of operations could be eliminated.

2. Ordinary spectacles should be made of armor plate or shatterproof glass. This would raise the initial cost slightly but would reduce ocular injuries and save in replacement costs as well as in loss of manpower.

3. Each soldier should be provided with two pairs of glasses. If the entire issue were not shatterproof, as suggested, the glasses to be worn in combat should be shatterproof. The numerous glasses lost in amphibious landings indicated the necessity for the provision of two pairs per man. The pair not

in use could be attached to the belt or to some other part of the person in a shatterproof case, such as the metal case provided for German soldiers.

4. The eight varieties of frames supplied in the Army during World War II should be reduced to a single style, of improved quality, and should be standardized.

5. More important than any of these provisions is the establishment of some method of recording prescriptions for glasses by which they would be readily available. Since the service record proved completely unsatisfactory for this purpose in World War II, the pay-data card might be considered as a possible substitute. It was proposed, during the war, that the prescription be recorded on the identification tag or that a third tag be provided for this purpose. It was likewise suggested that each man who wore glasses should be given a copy of his prescription and should be made personally responsible for its safekeeping. How many unnecessary refractions were performed in the Mediterranean theater it is not possible to say, but it is known that a large proportion of re-refractions could have been avoided, with a consequent saving of time, money, and manpower hours, if prescriptions for the glasses worn had been available.

CHAPTER IV

Management of Battle-Incurred Injuries of the Eye in the Mediterranean Theater of Operations

Trygve Gundersen, M. D.

EVACUATION

The ophthalmologic survey undertaken in the Mediterranean theater in January 1944 revealed certain errors of evacuation. The fundamental fault was that there was no special triage of soldiers with injured eyes.[1]

The primary repair of an injured eye is almost always a definitive operation. There is seldom a second chance to improve the situation. Corneal and scleral suturing, extraction of intraocular foreign bodies, and other surgical procedures for traumatic conditions demand greater judgment and skill and better equipment than almost any other ocular surgical procedures.

Because of these considerations, soldiers with injured eyes should have been brought as rapidly as possible to the best ophthalmologists in the Mediterranean theater. Lack of highest priority in triage kept this from being done. The casualties were sometimes brought to hospitals which had no ophthalmologists on their staffs (p. 50). They were often brought to hospitals which had on their staffs ophthalmologists of only limited training and experience (p. 49). At the time of the survey, well-trained and highly experienced ophthalmologists were attached to only 4 of the 11 evacuation hospitals in the theater, and 2 of the 4 were not functioning normally; the 9th, in Naples, was receiving French casualties, and the 59th, in Palermo, was functioning as a general hospital. Casualties were distributed without regard to these considerations, and each evacuation hospital was receiving an approximately equal number.

Investigation of individual cases revealed that evacuation was faulty in certain details as well as in general principles. Some soldiers who had received surgical treatment in forward areas were evacuated too soon (within 24 hours) after operation. Almost all were evacuated without immobilization of the eyes by a binocular bandage. Others were retained for unduly long periods of time in hospitals (such as station hospitals) which were neither staffed nor equipped to recognize and to manage properly the complications of major eye surgery.

[1] A statistical presentation of injuries of the eye in the United States Army during World War II is contained in appendix A, p. 556.

CLINICAL POLICIES

Because no consultant in ophthalmology served in the first months of fighting in the North African theater, no policies for the management of wounds and injuries of the eye were promulgated. Later, when a temporary consultant was appointed, instructions were issued in various circular letters [2] from the theater surgeon's office concerning first-aid care, criteria for enucleation, and similar matters. In general, the following clinical policies were followed:

1. As soon as the wounded man was seen both eyes were covered with sterile dressings. This was the most essential phase of first-aid care, though in many instances it was disregarded, one reason being that the wounded man himself frequently objected to having both eyes covered. Circular Letter No. 16,[3] issued 9 June 1943, warned that wounded evacuated by water, particularly during the early phases of combat, should be so bandaged and splinted that they could swim, or at least remain afloat, should the emergency require it.

2. The patient was evacuated in a recumbent position, particularly if it was suspected that a penetrating wound of the eye was present, in order to prevent the escape of vitreous. Military exigencies, however, sometimes prevented this position during evacuation.

3. The eyes were inspected at the first-aid station. They were washed out with boric acid or saline solution to remove loose foreign bodies and, after the instillation of 1 percent atropine and the application of an anesthetic ointment, were again covered with a binocular bandage. The objective of the application of ointment was to prevent spasm which would delay examination and treatment.

4. The soldier's own first-aid kit throughout most of the war contained sulfa pills, which were taken immediately after wounding.

5. Sedation was employed as necessary but was not usually required if the eyes were kept covered. Many men with perforating wounds of the eye did not realize that they had sustained them.

6. From the first-aid station, the patient was transported, as rapidly as possible, to an evacuation hospital, where the eyes were again inspected. Ideally, all patients with serious ophthalmologic injuries were sent on from the evacuation hospital to an eye center. A high priority of evacuation was given to patients with perforating wounds of the eye.

7. If the soldier had received wounds of other parts of the body as well as of the eye, his evacuation depended upon the extent and location of the

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[2] (1) Circular Letter No. 13, Office of the Surgeon, Headquarters, North African Theater of Operations, 15 May 1943, subject: Memoranda on Forward Surgery. (2) Circular Letter No. 20, Office of the Surgeon, Headquarters, North African Theater of Operations, 22 June 1943, subject: Tunisian Campaign—Comments by Hospitals of the Zone of Communications on the Treatment of Battle Casualties in Forward Areas. (3) Circular Letter No. 8, Office of the Surgeon, Headquarters, Mediterranean Theater of Operations, 10 Mar. 1945, subject: Notes on Care of Battle Casualties.

[3] Circular Letter No. 16, Office of the Surgeon, Headquarters, North African Theater of Operations, 9 June 1943, subject: Memoranda on Forward Surgery Especially Applicable to Amphibious Operations.

other injuries. If they were of such a nature as to render him nontransportable, he was treated at the field hospital, and the surgeon there did what he could with the wounds of the eye. It was not thought justified to bring an ophthalmologist forward to care for a single patient.

8. Repeated warnings were issued against excision of the eyeball in forward areas or soon after injury unless its removal was part of the necessary debridement. It was emphasized that sympathetic ophthalmia was not an immediate risk (p. 76).

9. Wounds and lacerations of the eyelid were sutured by special techniques in accordance with the ophthalmic surgeon's choice and judgment.

10. Roentgenologic examination was carried out as soon as possible to determine the presence of possible intraocular foreign bodies. It was emphasized that exact, accurate localization was essential for the removal of these bodies, and it was stressed that, if circumstances were not ideal for their immediate extraction, delayed removal was preferable (p. 232). It was found difficult to teach and enforce this concept in all forward hospitals.

11. Paracentesis and similar measures were not employed in intraocular hemorrhage unless secondary glaucoma was present. Intraocular hemorrhage was usually treated conservatively with bed rest (14 days or more) and binocular bandages. If secondary glaucoma developed because of hemorrhage into the anterior chamber, the blood was evacuated through a corneal incision.

12. When enucleation was performed, after the proper interval of delay, preferably not until the patient had reached an eye center, operation with glass-ball implantation in Tenon's capsule was the procedure of choice. Evisceration was limited to cases complicated by purulent endophthalmitis or orbital cellulitis.

13. Drugs were used locally only when indicated. Atropinization was avoided as much as possible, because it was thought to increase the danger of secondary glaucoma. Sulfonamide therapy was used routinely in penetrating wounds of the eye until the introduction of penicillin, which became generally available in the spring of 1944.[4] When it was used alone and not in combination with sulfa drugs, a somewhat higher incidence of ocular infections was observed, possibly because of the lesser penetrating powers of penicillin.

With the exceptions just stated, the policies employed in ophthalmic surgery in the Mediterranean Theater of Operations followed in general the policies followed in civilian ophthalmologic practice. Since the level of civilian practice is high, the level of ophthalmologic practice in the Mediterranean theater was, on the whole, equally high, particularly in the later months of the war when there was more general appreciation of the special problems of military ophthalmology.

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[4] Circular Letter No. 28, Office of the Surgeon, Headquarters, North African Theater of Operations, 1 July 1944, subject: Penicillin Therapy in Wound Management, Surgical Disease, Burns, and Anaerobic Infections.

SPECIAL CONDITIONS AND PROCEDURES

As pointed out elsewhere (p. 78), at the time of the survey in January and February 1944, intraocular foreign bodies were not being managed in all instances as promptly or as well as they should have been. The ratio of lost eyes to the total number of perforating wounds and intraocular foreign bodies was not available at the time of the survey, and, perhaps, because of the numerous variables, the figures will never be of absolute value. The impression was obtained, however, both from this survey and from observations at the 6th General Hospital, that the loss of injured eyes was higher in the Army than in civilian and industrial practice.

Corneal lacerations were not always properly sutured. Iridectomies were not always well performed. Conjunctival flaps were not applied as often as they should have been. Immobilization of the injured eye with binocular bandage or pinhole spectacles was seldom advised or carried out.

Primary suturing of lacerated lids was generally well done. Good suture material was available, and ophthalmologists and plastic surgeons worked in excellent cooperation, with plastic surgeons doing the work in hospitals to which ophthalmologists were not assigned.

Enucleation

So far as could be determined, no instance of sympathetic ophthalmia had occurred in the theater up to the time of the 1944 survey. The exact incidence of this complication following perforating wounds of the eye is debatable. Duke-Elder[3] estimated it at 2 percent. The statistics, however, are always qualified by the fact that the most dangerous eyes, in which sympathetic ophthalmia might be expected to occur, are usually removed before the period of danger begins.

Up to February 1944, 78 patients were received at the 6th General Hospital after the removal of an eye. In 21 additional cases, enucleation was performed at the hospital after an interval of 3 weeks had elapsed since the eye was injured. In 4 of these cases, vision was reduced to nil in the injured eye more than 3 weeks before the enucleation, which meant that in each of these 4 patients there had been an unnecessary risk of sympathetic disease, since vision had already been lost in the affected eye.

Criteria for delayed enucleation.— It is a sound general principle that eyes should be enucleated in relation to a theoretic ideal curve (fig. 7) extending over a 3-week period. With few exceptions, all injured eyes destined for blindness should be removed before the 21-day deadline; the few exceptions are those eyes in which the chance of regaining useful vision outweigh the real danger of sympathetic disease. About 95 percent of all eyes which must be enucleated can be managed according to the ideal curve. A few eyes will

[3] Duke-Elder, W. S.: Textbook of Ophthalmology. St. Louis: C. V. Mosby Co., 1949.

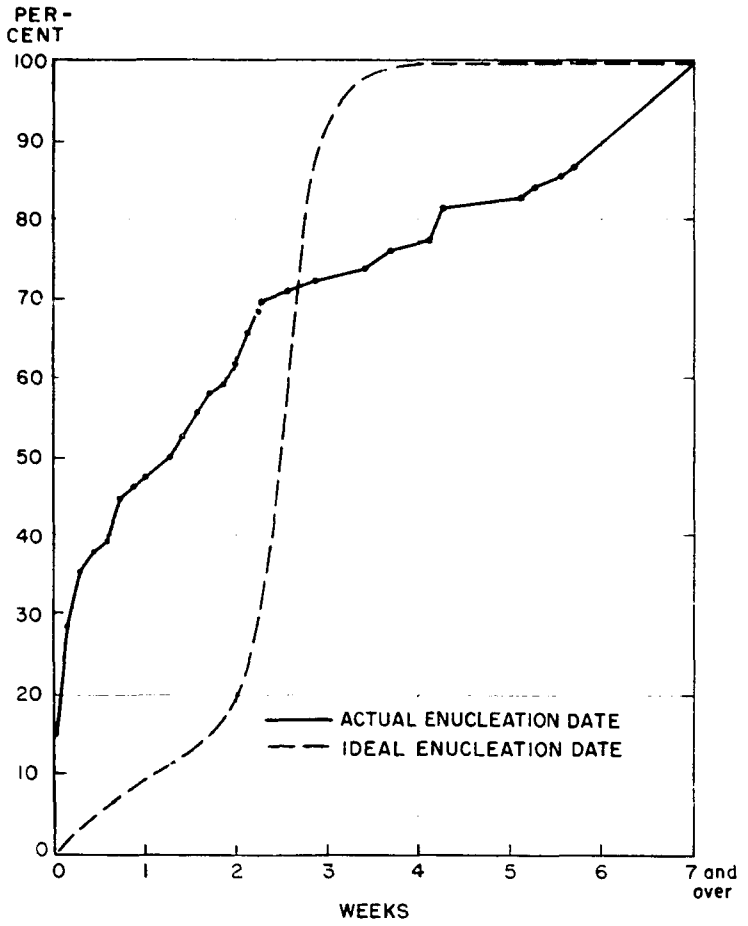


FIGURE 7.—Cumulative frequency chart representing time interval between eye injury and enucleation (curve based on 76 cases at 6th General Hospital and ideal curve).

have been completely avulsed by injury, and others, with severed optic nerves, will have been excised as part of the initial debridement. Otherwise, the very gradual rise in the ideal curve during the first week after wounding suggests that no eyes need be enucleated during that period. The majority should, however, be removed during the third week, which permits a 2-week chance of recovery without, at the same time, risking sympathetic disease. Enucleation is not more difficult because of the period of delay, and, when this practice was followed during the war, it usually permitted evacuation to a better staffed hospital for a second opinion. The comparison of the ideal curve of enucleation with the curve of the cases observed at the 6th General Hospital indicates that enucleations in the Mediterranean Theater of Operations during World War II were being carried out too soon after wounding, particularly during the first week.

Technique.—The ophthalmologic survey made in January and February of 1944 showed that reconstruction of orbits by implantation of Mules' glass

spheres was not being practiced often enough and that the omission was directly responsible for numerous badly shrunken orbits. This procedure, to be successful, must be done at the time of enucleation. Secondary implantations are difficult and seldom are successful. There were several reasons, however, for the omission. One, which was later corrected, was the original faulty distribution and deficient supply of Mules' glass spheres. Another was too early enucleation, often in hospitals in which spheres were not obtainable. The final reason was that many ophthalmologists lacked experience in, or were unfamiliar with, the procedure of implantation.

Up to the time of the survey, glass-ball implantation had been omitted in 43 of the patients received at the 6th General Hospital after enucleation had been done elsewhere. Spheres had been implanted after 17 enucleations performed at this hospital, with successful results in all but one case, in which extrusion occurred as the result of a mild wound infection. Although one of of the patients had previously had an evisceration, it was still possible to excise the remaining sclera and implant the glass ball successfully.

In the final survey of material from the 6th General Hospital, it was found that the following techniques had been employed in the 132 enucleations performed on 130 patients whose eyes had been removed in the course of the war: Simple enucleation, 55; enucleation with implantation of glass or plastic ball, 60; reimplantation of glass ball, 3; and evisceration, 5. In the remaining nine cases, there was no information available concerning technique.

Intraocular Foreign Bodies

The ophthalmologic survey made in the winter of 1944 revealed that intraocular foreign bodies were not being treated properly, chiefly because they were not being treated as promptly as they should be. In a series of 28 cases treated at the 12th General Hospital between February and October 1943, the time interval between injury and operation was found to have varied from 3 to 40 days and to have averaged 15 days, though only three of these casualties had other injuries which would have prevented their prompt evacuation to competent ophthalmic surgeons. In many of these cases, long periods of delay had permitted the foreign body to become so firmly fixed in organizing blood clot and exudate that the optimum anterior extraction technique (drawing the foreign body forward around the lens and through the pupil, with extraction through a corneal incision) was impossible with a magnet, while at the same time the risk of detachment of the retina by adhesion to the foreign body was introduced. All 14 of the foreign bodies eventually removed in this series of 28 cases had to be removed by scleral incision, which many ophthalmologists regard as a much less desirable technique.

Between 1 March 1943 and 1 February 1944, 18 soldiers with intraocular foreign bodies not removable by the hand magnet by the anterior route were received at the 6th General Hospital. They constituted 0.12 percent of the

hospital admissions and 0.78 percent of the battle casualties received during t[illegible]riod. Over the same period of time, 78 soldiers were admitted after e[illegible]ion had been performed. It is not known how many of the enucleated e[illegible]were injured by perforating foreign bodies which either had not been removed or had caused such damage to the eyeball that enucleation was necessary, but experience and observation suggested that early treatment might have spared at least some of these eyes.

What has been said does not, of course, imply that the removal of foreign bodies from the eye was an emergency procedure which could not be delayed. Generally speaking, the sooner such objects can be removed, the better, but the operation could be undertaken (or should have been undertaken) only in hospitals staffed and equipped for such an undertaking, for which roentgenologic localization was practically always necessary.

The rapidity with which foreign bodies become firmly embedded in tissues is not accurately known, though it is known that the time varies with the tissue concerned, the si[illegible] shape of the foreign body, and the amount of hemorrhage surroundi[illegible]ere the period of time plotted against the rapidity of embedding, t[illegible]bable that the curve of embedding would rise rapidly during the period of blood clotting but only slowly thereafter. In the absence of infection, which was [illegible] a great problem in World War II because of the use of chemotherapy and antibiotic therapy, it therefore made not great difference whether the foreign body was removed between the second and sixth hours after wounding or between the second and sixth days. Frank intraocular suppuration occurred only in those eyes which were heavily inoculated with virulent organisms, and it is doubtful that early removal of foreign bodies would have saved many of these. On the other hand, some eyes were undoubtedly lost in the early days of World War II in the Mediterranean Theater of Operations because the removal of foreign bodies was unnecessarily delayed.

Initial damage.—The great majority of soldiers struck by flying bits of metal or other objects experienced enough pain and disability to report for medical care as promptly as possible. The initial damage to the eye, however, could not always be estimated at the time of injury or even for a few days thereafter. Records made by competent ophthalmologists often showed no vision on the first examination, while examination a few days later showed definite light perception. For this reason alone, immediate enucleation was not warranted except in extensive injuries in which it was part of the general debridement.

Wounds of the lens, per se, did not justify immediate enucleation though they strongly influenced the decision for it if other injuries precluded the possibility of clear media to a normal macula. Wounds of the ciliary body, as had long been recognized, were the most dangerous of all injuries from the standpoint of the development of sympathetic ophthalmia, and their presence also weighed heavily in favor of enucleation.

Intraocular hemorrhages made examination difficult and prognostication

uncertain. It was important to determine their extent and exact location. These hemorrhages might be from the retinal or uveal circulation and might occur in the anterior chamber, vitreous, retina, or uveal tract. It was found best to evacuate blood from the anterior chamber promptly by surgical measures if the hemorrhages were associated with glaucoma. Hemorrhages into the vitreous showed great variation in the rapidity and degree of absorption, but, with the exceptions noted, it was best to give them every opportunity for spontaneous absorption. Choroidal hemorrhages were usually extensive and quickly caused irreparable damage to the overlying retina. When they were present, the prospects for a return of useful vision were poor.

Because more anteriorly situated hemorrhages obscure the view of deeper hemorrhages, it was necessary for examiners to rely on subjective examinations to determine the extent and location of deep bleeding. Since the prognosis for hemorrhage into the vitreous is quite different from that for hemorrhage into the subchoroidal space, it was particularly important to differentiate between them. Differentiation could often be made by examining the visual field with a point source of light of low intensity. The May or National ophthalmoscope, after the condenser had been removed from the bulb, proved an ideal test object.

Nature of the foreign object.—Early in World War II, it was learned that the increased velocity of flying missiles resulted in a different kind of wound from that previously encountered in wartime. A tiny shell fragment, with a wound of entry so small that it defied detection, often caused explosive destruction of tissues underneath the surface. This was as true of ocular injuries as of injuries elsewhere in the body. Many eyes were struck by foreign bodies which, while minute, were of such high velocity as to cause catastrophic injuries to the retina and choroid.

The nature of the foreign bodies encountered in World War II also differed materially from the nature of those encountered in civilian practice. In civilian practice, one usually found single chips of metal from chisels, hammers, rivets, nails, and the like, with an occasional nonmagnetic birdshot or fragment of copper detonation cap. In contrast, during the war, multiple foreign bodies were seen by all military ophthalmologists. Many eyes contained both magnetic and nonmagnetic particles. In addition, though this was not realized until examinations had been made in the Army Institute of Pathology, many eyes contained secondary foreign bodies such as particles of paint, vegetable matter, skin, and cilia, carried in by the primary missile. Preoperative knowledge of these facts would undoubtedly have hastened the decision to enucleate many eyes.

Before the war, there was general understanding that foreign bodies vary greatly in their toxicity to tissues. Those of high atomic weight are unusually inert. Gold, silver, and platinum are well tolerated within the eye. Lead and zinc are less well tolerated. Copper and iron, especially soft iron, oxidize rapidly and cause the well-known clinical pictures of siderosis bulbi and chalcosis.

World War II brought to the attention of military ophthalmologists some less well-known materials. Plexiglass and other plastic materials often caused no intraocular inflammation whatever. Bits of rock and soil were frequently blasted into the eyes by mines and shells exploding in the ground. When dozens of these bits were embedded in the cornea at different depths, the relative toxicity of the various fragments could be studied with the slit lamp. Limestone particles invariably caused edema and softening of the surrounding cornea and attracted blood vessels rapidly. Also, the tracks of entry remained soft and unhealed. Crystalline rocks, such as granite and quartz, caused almost no reaction and usually were well tolerated. Since an analogous tissue reaction occurs when foreign bodies of this kind are intraocular, it was readily understood that there was a great variation in the degree of endophthalmitis caused by different types of rocks and minerals.

Criteria for removal. There are probably no magnetic foreign bodies which defy removal with magnets and with the anterior and posterior approaches available to the modern ophthalmic surgeon. The first principle in the removal of a foreign body, however, is to do no harm. It was repeatedly demonstrated in World War II that harm could be done by too great zeal in attempting the removal of these particles, especially in the absence of proper diagnostic and surgical equipment and of competent ophthalmic personnel.

Nonmagnetic foreign bodies present different problems and must be removed either under direct vision or, if this is impossible, under indirect vision with the aid of some ingenious device like the Thorpe endoscope. Localization of the body must be of pinpoint accuracy to avoid failure or calamity. These requirements could not always be met under military conditions.

Route of removal. Even before the outbreak of World War II, the pendulum had swung so far from the anterior toward the posterior route for the removal of foreign bodies that many surgeons were inclined to use the latter exclusively. Some were actually unfamiliar with the anterior route, and others were unwilling to admit that it had any place in surgery. Perhaps the intimacy with the posterior segment of the globe gained through operations for detachment of the retina had given ophthalmic surgeons a feeling of security in incising normal retina and choroid to extract an underlying foreign body. On the other hand, many surgeons continued to think that, regardless of its location, it was far wiser to draw a foreign body forward into the anterior chamber and extract it through a corneal incision. Only when this procedure had failed, after repeated attempts on successive days, did they believe it justifiable to resort to posterior sclerotomy. The pars planum approach advocated by Verhoeff was devised to minimize operative injury in just such cases.

All of these facts had to be taken into consideration by military ophthalmic surgeons. Each method obviously had its advantages as well as its disadvantages and dangers. When the sclera, uvea, or retina is incised, there is always danger of hemorrhage, though the risk is reduced by preliminary diathermy

coagulation of the sclera and underlying blood vessels. Detachment of the retina, which occurs in a definite number of patients who have had posterior operations, offers little hope of cure, presumably because solid vitreous actually separates the retina from the choroid. The danger of sympathetic ophthalmia is slightly increased by posterior segment operations, the danger probably being greater in incisions through the ciliary body than in those through the choroid. Anterior route extractions, on the other hand, can cause the retina to be torn or even pulled off when the foreign body is firmly embedded in it or is attached to it by inflammatory adhesions. There is also a possibility of injury to the clear lens, though this danger can be avoided by using care in planning the path of the fragment as it is withdrawn. The anterior route is less desirable for large foreign bodies, which cause extensive tearing of the zonule. Danger of sympathetic ophthalmia is not especially increased by the additional keratotomy.

Under ideal circumstances in military surgery, a foreign body seen in the vitreous with no attachment to the retina was removed by a carefully executed anterior extraction, which was still the operation of choice even when hemorrhage or cataract obscured the object. On the other hand, foreign bodies under or in the retina or attached to it were most often removed by direct scleral incision, although it had to be borne in mind that each of these patients was then a candidate for potential detachment.

Since soldiers were often literally sprayed with hundreds of fine fragments from a single exploding shell, bomb, or mine, both eyes were often injured by multiple foreign bodies. In an occasional case, a single wound of entry was associated with the presence of many intraocular foreign bodies. In one such case, a sergeant, strafed by low-flying enemy aircraft, continued firing his 50-caliber machinegun until he was severely wounded. One eye was completely destroyed. In the other was a single 3-mm. wound of the cornea, but scattered over the entire surface of the iris and lens were myriads of particles which had the appearance of lead. The eye remained relatively quiet for 14 days. Then a purulent endophthalmitis suddenly developed, which completely destroyed the globe. Roentgenologic examination of the enucleated globe showed more than 50 individual particles. The only possible explanation of such injuries seems to be that the eye was perforated by molten metal, which scattered through the aqueous as it solidified.

Apparatus and instruments.— The Carney locator (p. 241) supplied useful information concerning the location of foreign bodies. It was of value in determining the point on the sclera nearest to the foreign body and, therefore, in determining the proper site for incision. Its use also reduced the number of roentgenologic examinations required and sometimes eliminated them entirely. In the opinion of many observers, however, this locator supplied no information which could not equally well be obtained by precise roentgenologic localization. It was of no value when the foreign bodies were nonmagnetic. Details of localization are discussed elsewhere (p. 236).

The Lancaster hand magnet, which was authorized for every United States Army hospital, proved exceedingly useful. The fact that each instrument had its own rectifier and that the entire assembly fitted into a small compact case made this type of magnet especially useful in highly mobile hospitals. The Lancaster hand magnet is not designed to exert a constant magnetic force over a long period of time, and many instruments were burned out by operators who did not understand that, if a foreign body was not attracted the moment the switch was turned on, it would not be attracted by keeping the current flowing through the magnet until the coils became hot.

Giant magnets were principally useful in anterior route extractions. Because of their size and weight, their use was practical only in large, fixed hospitals. They had not been provided in the Mediterranean theater when the first survey was made, and it was therefore impossible at that time to extract small and only slightly magnetic intraocular foreign bodies (p. 54). Eventually, this lack was corrected. Lancaster's model, which was made available to specially designated Army hospitals, was equipped with a large motor generator. Unfortunately, it had no direct switch or cutoff between the converter and the magnet, which would have given the operator the advantage which comes with the initial inflow of current through the coil. These switches were usually added by electricians assigned to the hospitals.

The One-Eyed Soldier

The problem of supplying artificial eyes in the Mediterranean theater (p. 60) was basically the problem of what to do with the men who needed them. Until the end of the war, men who had been inducted with only one eye continued to enter the theater. These handicapped men were assigned to suitable duties and thereafter demanded no special consideration other than their requirements for prosthesis.

An entirely different problem was presented by soldiers who had lost an eye in service, particularly if the eye had been lost in combat. No general policy for the disposition of these men was ever established in the theater, and in May 1945, when the fighting in Italy ended, there was still no agreement about how best to handle them. At that time, 41 ophthalmologists were asked for their opinions. Of these, 13 did not express an opinion, 14 believed that these men should be returned to the Zone of Interior, 9 believed that they should be assigned to limited duty in the theater, and 5 were of the opinion that each case should be judged on its own merits. Actually, of a total of 258 men who had lost one eye, 49 had been retained in the theater with limited-duty assignments, and 209 had been evacuated to the Zone of Interior.

Ophthalmologists in favor of evacuating one-eyed soldiers to the Zone of Interior based their opinion on both practical and sentimental reasons, as follows: There was a lack of rehabilitation facilities in the theater; one-eyed soldiers were frequently assigned to inappropriate duties and as a result were

discontented, were always reporting on sick call, and were generally bad influences; and there was always the possibility of serious injury to the remaining eye, or to the man himself, or to his associates because of his handicap; and similar reasons. The lack of prosthesis in the theater, which was a valid reason for evacuation in 1943 and early in 1944, disappeared when a supply of artificial eyes was received later in 1944.

The arguments advanced by ophthalmologists who believed that men who had lost an eye should not be evacuated to the Zone of Interior were as follows: If the man had a skill which could be advantageously employed, or could be taught one, he should be retained in the theater. There would be less chance of his developing neuroses or unwholesome mental attitudes if he was kept at work and his defect was deemphasized. Actually, one-eyed men were more useful to the Army than men with chronic mastoiditis, otitis media, or other conditions requiring continuing treatment in outpatient dispensaries and infirmaries. It was, of course, essential that those responsible for the man's assignment and guidance should understand the limitations imposed by loss of depth perception and visual field, as well as the difficulty in judging distance and the fact that the use of a single eye may be fatiguing if acute visual discrimination is necessary in the work assigned.

This problem was not satisfactorily settled and was still a problem when the fighting ended.

Diseases of the Eye

Generally speaking, the diseases of the eye encountered among soldiers in the Mediterranean theater were much the same as those which would be encountered in men of a similar age group in civilian life.[6]

Epidemic conjunctivitis, especially the variety caused by *Hemophilus influenzae*, presented no problem, although the disease assumes large proportions every summer (July-September) among native inhabitants of North Africa, as well as among Europeans residing there. Only three cases were seen at the 6th General Hospital, and other installations reported an equally low incidence.

The almost complete absence of trachoma among United States troops in a trachoma-infested region was also notable. Only 8 cases were observed at the 6th General Hospital during the 11 months of its operation at Casablanca in French Morocco, and 5 of these had been contracted prior to foreign service. These cases occurred in 14,281 hospital admissions and 2,787 clinic entries. The figures do not include civilian workers and prisoners of war seen in the hospital. Each case of trachoma was evaluated individually. Routine transfer to the Zone of Interior was not the practice.

No case of gonorrheal ophthalmia was diagnosed, in the hospitals surveyed in the Mediterranean theater, nor was a single instance of epidemic kerato-

[6] A statistical presentation of diseases of the eye in the United States Army during World War II is contained in appendix A, pp. 549–555.

conjunctivitis (shipworkers' conjunctivitis) seen. The occasional case in which this diagnosis was made did not seem to conform with the accepted description of the disease.

The ophthalmologic survey conducted in the Mediterranean theater in the winter of 1944 revealed that the care of patients with the ophthalmologic disease of nontraumatic origin was generally satisfactory. Only four significant errors of treatment were observed:

1. There was a tendency to overtreat ocular inflammation, particularly conjunctivitis and keratitis of obscure origin, and mechanical irritation caused by the treatment was therefore prolonging the natural course of the disease in some instances.

2. Drugs were sometimes used injudiciously. This comment applied particularly to the general and continued use of Butyn Sulfate (butacaine sulfate) and Metaphen (nitromersol) ointments. These were the only ointments other than yellow oxide of mercury (to which many ophthalmologists have a strong prejudice) available in the Mediterranean theater in the first months of fighting. Any local anesthetic applied to corneal epithelium checks its metabolism and inhibits its regeneration, and the use of these ointments often caused corneal damage (p. 56).

3. Frequently, no local medication was supplied to casualties during evacuation. This omission was particularly harmful if they were in transit for 24 hours or more. It was also particularly harmful if eyes were inflamed and required mydriasis. In several instances, men in this category arrived at the 6th General Hospital with complete posterior synechiae of the iris.

4. There was a rather general failure to recognize herpes simplex corneae (dendritic keratitis) and to treat it properly. Patients with this disease were observed in almost every hospital and only exceptionally were they being properly treated.

STATISTICAL DATA

In all wars, the regional incidence of body wounds has corresponded roughly to the relative surface expanse of the various parts of the body. This is not, however, true of the eye. The frontal view of the body silhouette comprises approximately 4.2 square feet, of which the profile surface of the spherical eyeball constitutes only 0.1 percent (0.78 square inch). The incidence of ocular injuries in warfare is at least 10 times higher than would be anticipated from their surface expanse. Injuries of the eye, furthermore, are always important. A small corneal abrasion or a minute foreign body under the lid could completely disable the soldier from a military standpoint, while a perforating wound of the globe, even by a minute foreign body, always required evacuation. A similar wound of a less vulnerable part of the body might not have this result.

When the ophthalmologic survey was undertaken in 1944, it was found

that accurate statistics concerning eye injuries were not available for the following reasons:

1. The hospital registrar's form for reporting injuries had no provision for injuries of the eye, which were therefore entered, with complete loss of their identity, under other regional categories, chiefly maxillofacial injuries.

2. If the patient had multiple injuries, as he frequently did, classification was under the category of the most extensive wound, which was not usually considered to be the eye injury.

3. It was not practical for the surveyors to collect statistics in the various hospitals visited. The evacuating process was a continuing one and was speeded up during periods of military activity so that the same patients would probably have been encountered in more than one hospital and counted more than once.

Two plans were therefore adopted to secure the obviously essential data concerning the incidence of diseases and injuries of the eye in the Mediterranean theater:

1. The records of the 6th General Hospital, to which the ophthalmologist who made the survey had been attached for 11 months, were used as source material. From 1 March 1943 to 1 February 1944 a total of 14,281 patients had been admitted to this hospital. It had functioned both as a general and as a station hospital and had evacuated patients directly to the Zone of Interior. In addition to the official Army records of diseases and casualties, there were available, in it, the completely independent records kept on the ophthalmologic service for each patient treated. These independent records provided information not available on the official Army forms.

2. A spot check was made on a selected date (20 March) of all hospitals in the theater to count patients under treatment on that special day for diseases and injuries of the eye.

These methods proved so satisfactory that the records of the 6th General Hospital were used for a final survey of ophthalmologic material in the theater, and three additional spot checks were carried out 25 June 1944, 25 September 1944, and 25 February 1945 (table 3).

Total Theater Material

The spot check of all hospitals in the Mediterranean theater on 20 March 1944 revealed the total hospital census from all causes to be 33,861 (table 3), of which 672 cases (1.98 percent) were diseases and injuries of the eye. A breakdown of these figures showed that, at this time, diseases of the eye accounted for 1.68 percent of all admissions for disease, non-combat-incurred injuries of the eye accounted for 2.06 percent of all such injuries, and combat-incurred injuries of the eye accounted for 2.61 percent of all combat-incurred injuries. These proportions varied somewhat in the subsequent checks (table 3).

TABLE 3.—*Data for diseases and injuries of the eye obtained by spot check of all hospitals in the Mediterranean Theater of Operations as compared with those of the 6th General Hospital*

[The data from the various hospitals in the theater were secured by spot checks carried out on the dates specified. Data from the 6th General Hospital are for the period March 1943 through December 1944]

Census	All hospitals, Mediterranean Theater of Operations										6th General Hospital	
	20 March 1944		25 June 1944		25 September 1944		25 February 1945		Average			
	Number	*Percent*	*Number*	*Percent*	*Number*	*Percent*	*Number*	*Percent*	*Number*	*Percent*	*Number*	*Percent*
Total United States Army hospital census [1]	33, 861	100. 00	27, 906	100. 00	23, 565	100. 00	20, 315	100. 00	26, 412	100. 00	26, 223	100. 00
Battle casualties	9, 361	27. 65	11, 509	41. 24	7, 924	33. 63	2, 670	13. 14	7, 866	29. 78	7, 090	27. 04
Injuries	4, 282	12. 65	4, 226	15. 14	3, 412	14. 48	3, 103	15. 27	3, 756	14. 22	4, 504	17. 18
Diseases	20, 218	59. 70	12, 171	43. 62	12, 229	51. 89	14, 542	71. 59	14, 790	56. 00	14, 629	55. 78
Eye cases	672	1. 98	604	2. 16	553	2. 35	352	1. 73	545	2. 06	[2] 1, 936	7. 38
Combat eye injuries	244		248		224		99		204		241	
Percent of all eye cases		36. 31		41. 06		40. 51		28. 13		37. 43		12. 45
Percent of hospital census		. 72		. 89		. 95		. 49		. 77		. 92
Percent of all combat injuries		2. 61		2. 15		2. 83		3. 71		2. 59		3. 40
Accidental eye injuries	88		94		68		45		74		275	
Percent of all eye cases		13. 10		15. 56		12. 30		12. 78		13. 58		13. 17
Percent of hospital census		. 26		. 34		. 29		. 22		. 28		. 97
Percent of all accidental injuries		2. 06		2. 22		1. 99		1. 45		1. 97		5. 66
Eye diseases	340		262		261		208		267		1, 110	
Percent of all eye cases		50. 59		43. 38		47. 19		59. 09		48. 99		74. 38
Percent of hospital census		1. 00		. 93		1. 11		1. 02		1. 01		5. 49
Percent of all admissions for disease		1. 68		2. 15		2. 13		1. 43		1. 81		9. 84

[1] Does not include prisoners of war or allied troops.

[2] Does not include 3,075 patients seen in the outpatient clinic for refraction, of whom 1,374 were given glasses. In all, 14,493 visits were paid to the outpatient clinic in the period in question.

6th General Hospital Material

The records of the 6th General Hospital for the 11-month period ending 1 February 1944, supplemented by the special records kept on the ophthalmologic service, indicated that in this general hospital, which functioned at the end of an evacuation chain and served as a special eye center, the proportion of patients admitted primarily for injuries and diseases of the eye constituted 3.5 percent of 14,281 admissions. Battle-incurred injuries of the eye, which were frequently associated with other injuries, constituted 4.1 percent of all battle-incurred injuries.

A consolidated study of the material from this hospital as indicated for a 20-month period from March 1943 through December 1944 revealed that, over this period, of 26,223 total admissions for all causes, 1,936 (7.38 percent) were for injuries and diseases of the eye (table 3). These figures are exclusive of 1,090 patients treated in the outpatient clinics. They are also exclusive of the 3,075 patients for whom refractions were done and for 1,374 of whom (44.68 percent) glasses were ordered. The total number of patients seen in the eye clinic amounted to 6,101. The total number of visits to the clinic was 14,493.

Of all eye patients admitted to the hospital, 241 (12.45 percent) were battle casualties, 255 (13.17 percent) were admitted for accidental injury, and 1,440 (74.38 percent) for disease.

A comparison of the figures from the 6th General Hospital (table 3) with the figures for all the hospitals in the theater (secured by the spot checks and later averaged) reveal that at the 6th General Hospital (1) diseases of the eye formed a higher percentage of admissions for disease (9.84 as compared with 1.81 percent); (2) accidental injuries of the eye formed a higher proportion of admissions for accidental injuries (5.66 as compared with 1.97 percent); and (3) combat-incurred injuries of the eye formed a higher proportion of admissions for battle-incurred injuries (3.40 as compared with 2.59 percent).

There are several possible explanations for these discrepancies. One is that the proportions of various ocular conditions were naturally higher in a general hospital than in a group of installations which included hospitals in forward areas. Since men with eye injuries required prolonged hospitalization they were quickly evacuated from the front to eye centers. A second reason is that, for a part of the period in question, the 6th General Hospital functioned as 1 of the 6 specialized eye centers in the Mediterranean theater. The most important reason, however, is that the records of the hospital were more accurate than the records of the whole theater because a special effort was made by interested personnel to keep them complete and accurate.

Combat-incurred injuries.– Of the 241 patients with battle-incurred wounds of the eye admitted to the 6th General Hospital over the 20-month period in question, 53 had to be evacuated to the Zone of Interior because of these injuries. Only 21 patients in the entire group had injuries limited to

the eyes. In 134 of the 241 cases, the injuries were caused by foreign bodies, which were intraocular in 56 cases, intraorbital in 37, and intracorneal in 41. In 15 of the corneal injuries, fragments were present in both eyes. Twenty-five patients had perforating wounds of the eye without retention of foreign bodies.

In 5 percent of the 241 battle-incurred ocular injuries, no information at all was obtainable concerning how the wounds had been incurred. Information was not always precise in the remaining cases, but the histories suggested that 43 percent were caused by shell fragments, 26 percent by mines, 17 percent by gunshot wounds, 7 percent by grenades, and 1 percent each by shellblasts and by burns.

Non-combat-incurred injuries.— Of the 255 patients with non-battle-incurred injuries of the eye, 30 had to be evacuated to the Zone of Interior because of these injuries. In 194 cases, the injuries were uniocular. In 20 percent of the patients, the ocular condition was the result of injuries sustained before induction. Burns, vehicular accidents, fist fights, sports, mines and grenades, shellblasts, gunshot wounds, and aircraft accidents and explosions were responsible for the remaining cases, in that order of frequency, in addition to the 26.5 percent which resulted from miscellaneous causes.

Of the 34 injuries in this group caused by foreign bodies, 21 were in the cornea, 9 were intraocular, and 4 were intraorbital. Thirteen patients had perforating wounds of the eye without retention of foreign bodies.

Diseases of the eye.— Of the 1,440 patients admitted to the 6th General Hospital because of ophthalmologic disease (table 3), 48 had to be evacuated to the Zone of Interior for the following reasons: Chorioretinitis, 28; macular degeneration, 6; iritis, 6, which in 3 instances was unclassified; cataracts, 3; optic atrophy, 2; and macular edema, glaucoma, and corneal dystrophy, 1 each.

Operations.—A total of 382 operations, 114 of which were major procedures, was performed on the eye service of the 6th General Hospital during the 20-month period under consideration.

Blindness and impairment of vision.—Twenty-seven patients seen at the 6th General Hospital were industrially blind in both eyes,[7] 15 from battle injuries, 1 from a non-battle-connected injury, 4 from disease, and 7 from amblyopia. In two instances, both eyes had been enucleated. In the 18 other cases (exclusive of the 7 cases of amblyopia), 6 men had light perception in 1 eye and vision from 1/200 to 6/200 in the other; 4 had vision of 20/200 in 1 eye and from 20/200 to 20/70 in the other; and 8 had vision of 20/100 in 1 eye and of 20/70 in the other.

Sixteen patients observed at the hospital had been inducted into service with only one eye. Three hundred and eighty-five were industrially blind in

[7] Industrial blindness, which is used in this volume in its usual significance, is an accepted term generally employed to designate the status of an individual who no longer has sufficient vision to earn a livelihood because his eyes have been damaged by disease or injury. It implies a visual loss up to 20/70 or more. Industrial compensation is usually based on this definition of blindness.

one eye, though with few exceptions most of them had normal or almost normal vision in the other eye. Of the 385 patients, 104 suffered from amblyopia. One hundred and forty-two of the remainder were totally blind in the affected eye, eleven had only light perception, six could see only shadows, forty-four had vision from 1 200 to 18 200, thirty-four had vision of 20 200, and forty-one vision from 20 100 to 20 70. Three had aphakia. Exclusive of the 104 patients with amblyopia, 154 had sustained their unilateral blindness in combat and 72 in accidental injuries. In the remaining 55 cases, the blindness was the result of disease. The greater majority of the patients who had sustained their injuries accidentally had normal or almost normal vision in the other eye.

Thirty-six patients were seen with hysterical amblyopia. This condition is functional, not organic, and the prognosis in most cases was good.

Enucleation, evisceration, and phthisis bulbi.—Two soldiers treated at the 6th General Hospital during its period of activity were submitted to bilateral enucleation, after vision in both eyes had been completely lost. Sixteen of the one hundred and forty-four others had suffered the loss of one eye before induction into service. Ninety-nine of the enucleations were required because of battle injuries and the remainder because of accidentally incurred injuries. Among the battle-incurred injuries were 27 instances of intraocular and 8 of intraorbital foreign bodies with contusion of the globe, 11 ruptures of the globe, and 4 instances of phthisis bulbi. Three other patients with unilateral phthisis bulbi were discharged without operation. It is not clear why enucleation should have been carried out in 11 instances of cataract, 9 of corneal foreign bodies, and 5 of glaucoma.

The wounding agents in the 99 battle-incurred injuries which required enucleation included shell and mortar fragments in 35 instances, gunshot and machinegun missiles in 22, shell fragments in 16, mine explosion in 12, grenades in 6, a bomb in 1, and unknown agents in 7 (all intraocular foreign bodies). The 31 accidentally incurred injuries which required enucleation were caused by boobytraps in 7 instances; baseballs, rocks, and other objects, in 7; accidents on the rifle range, in 5; improperly handled tools, in 4; shell fragments, in 3; and a jeep accident and a blow from the branch of a tree, in 1 case each. In the remaining 3 cases, the injuries had been sustained before the men entered service.

CHAPTER V

Administrative Aspects of Ophthalmology in the European Theater of Operations

Derrick T. Vail, M. D.

DEVELOPMENT OF THE CONSULTANT SYSTEM

The first senior consultant in ophthalmology in the European Theater of Operations, Lt. Col. (later Col.) Derrick T. Vail, MC, reported for active duty at Walter Reed General Hospital 9 September 1942, and reached his overseas station in Cheltenham, England, 2 October 1942. On 29 March 1945, he was succeeded by Lt. Col. James N. Greear, Jr., MC, who served until the end of the war in Europe. Like other consultants whose indoctrination in Army matters was brief, both in the Zone of Interior and overseas, the first senior consultant in ophthalmology in the European Theater of Operations found that his immediate usefulness would have been greater if he had received more adequate training in Army procedure and similar nonmedical matters which, during active warfare, play so important a part in the development of professional policies.

Functions of the Senior Consultant in Ophthalmology

The senior consultant in ophthalmology in the European Theater of Operations was charged with overall responsibility for the professional care of ophthalmologic casualties in that theater and with the development of professional policies relating to their care. He coordinated hospitalization plans, training, and supply with the appropriate divisions, and, in conjunction with the Supply Division, Office of the Chief Surgeon, he was in charge of the optical program, which was concerned with the supply of both spectacles and artificial eyes. It was his function to maintain liaison and cordial relationship with his Allied colleagues, to attend medical meetings, and to act as a member of the various subcommittees of the National Research Council of Great Britain which were concerned with ophthalmologic matters. He was personally consulted on difficult cases, not only in the United States Army but also in British, French, and Belgian Armies. He examined persons filing claims with the United States Government for ocular damage, investigated the circumstances, and reported to the Legal Division. Advice was given as requested by other divisions of the Office of the Chief Surgeon, European Theater of Operations.

Most of all, however, the duties of the senior consultant were concerned with the dissemination of information to, and the supervision and evaluation of, ophthalmologic personnel in the European theater. This was accomplished by frequent visits to the various installations and by personal contact with the officers working in this field. In the base and rear areas, he was supplied with adequate transportation and could move about at will. When, later after D-day, similar visits were made in army areas, permission first had to be obtained from the army headquarters concerned. As a rule, there was no difficulty in obtaining this permission, and freedom of movement within army areas was generally granted. On the other hand, it seemed incongruous to some that senior staff officers at the theater headquarters level, including consultants to the Chief Surgeon, were sometimes administratively restricted by subordinate commands in forward areas from carrying out their overall theater responsibilities. This was not a wholly satisfactory state of affairs. It is highly desirable that a senior consultant in any specialty should be recognized officially by virtue of his mission, should be provided with high-priority transportation, and should move about with the utmost freedom consistent with the tactical situation. Only under such an arrangement can the best professional care be provided for casualties. The consultant should be trusted not to abuse his position. If he does, he should be removed from it, but, as long as he occupies it, there should be no restrictions upon his access to installations and medical officers within the army area.

Regional Consultants

When the first senior consultant in ophthalmology arrived in the European theater there were only six United States Army hospitals in the United Kingdom Base, and supervision of the ophthalmic work in all of them could readily be accomplished. As the theater grew in size and additional hospitals arrived, supervision of all the eye services by a single consultant became physically impossible. At the same time, careful supervision became more and more essential because, due to a shortage of trained ophthalmologists, inexperienced officers were being required to handle work beyond their ability. The difficulty was overcome by the development of a system of regional consultants, appointed on the basis of professional experience and administrative ability, the number of whom, after D-day, was sometimes as high as 20. Each of these regional consultants was made responsible for the supervision of from 5 to 15 general and station hospitals, depending upon the number of installations in his immediate neighborhood. In addition, each consultant continued to carry out his regular duties in his own hospital.

Duties of the regional consultants were, for their respective areas, similar to those of the senior consultant in ophthalmology. They made frequent visits to the installations for which they were responsible. At each installation, they checked over equipment, apparatus, and supplies, making sure that they

were conveniently placed, correctly used, and maintained in good condition. They assisted in the handling of personnel problems. They made ward rounds and evaluated diagnosis and therapy. When requested to do so, they examined special patients and gave advice on diagnosis and treatment. They disseminated information concerning changing policies and interpreted directives. Finally, within limitations of their assignments, they carried out any other functions necessary to keep the ophthalmologic care of patients in their areas on the highest possible level.

The regional consultants submitted routine reports to the senior consultant in ophthalmology and, at intervals, met with him to discuss special problems and general policies.

PERSONNEL

Ophthalmologists

The method of classification employed by the Medical Department to denote the training and experience of medical officers worked very well on the whole, as far as ophthalmology was concerned. In most major hospitals, the ophthalmologists were well qualified. On the other hand, a field organization of the size eventually attained by the European Theater of Operations inevitably represented a cross section of the professional ability which would be encountered in any similar civilian cross section. Furthermore, as time passed, shortages in personnel began to become evident.

The first general hospitals which arrived in the theater, particularly the affiliated units, usually had competent ophthalmologists on their staffs. This was not true of the general hospitals arriving later, in which, as a rule, a single officer was assigned to handle both ophthalmology and otolaryngology. In most instances of this sort, the officer assigned to cover both specialties was far better qualified—was usually well qualified—to handle otolaryngology. He was seldom well equipped to handle ophthalmology, particulary ophthalmic surgery. In such installations, a natural though unfortunate tendency developed to assign much of the ophthalmologic work to the optometrist. Occasionally, ophthalmologic experience was developed at the expense of proper ophthalmologic care for the patients.

In station hospitals, a single medical officer was able to handle otolaryngology and ophthalmology quite satisfactorily, because ophthalmologic work in station hospitals was not intended to be definitive. Furthermore, some station hospitals had highly competent ophthalmologists on their staffs. There were few qualified ophthalmic surgeons assigned in the various field armies, and expert ophthalmologic care could not be carried out satisfactorily.

The situations described warranted and required some shifting of ophthalmologic personnel. This was not always easy. Even though an expert ophthalmologist might not be needed in a certain hospital, the commanding officer of the installation, for various local reasons, might not view matters

in the same light as the senior consultant in ophthalmology, and transfers were often secured with difficulty. Nor was it a simple matter to effect the transfer of a relatively high ranking, professionally weak officer from a general to a station hospital. Even though such an officer, because of his limited training, could best be utilized at the station-hospital level, assignment to this level was frequently a difficult and complicated matter, since the professional position to which an officer of relatively high rank could properly be assigned usually called for an officer of lower rank in tables of organization.

In occasional instances, the chiefs of surgical services in general hospitals, under which the ophthalmologic section functioned, had no clear concept of ophthalmic surgery, at least until battle casualties began to arrive, and were opposed to changes in personnel for this reason.

It was not until the policy was developed of grouping general hospitals into hospital centers that the care of eye casualties became perfectly satisfactory. In a hospital group, the probabilities were strong that there would be two or more competent ophthalmic surgeons on the combined staffs, and it was usually a simple matter to arrange with the commanding officer of the center that all patients requiring specialized care should be transferred to the hospitals in which the specialists were stationed. Hospital centers were not established until 1943, but their worth was promptly manifest, and they were particularly useful on the Continent after D-day.

Until late in 1943, when tables of organization were revised, it was only by chance that evacuation-hospital staffs included medical officers capable of caring for eye disease or injury. When the revision was carried out, the shortage of well-qualified ophthalmic medical officers was acute, and an ophthalmo-otolaryngologic officer was usually authorized. This officer was usually an otolaryngologist, not too well trained in his own specialty and practically without knowledge of ophthalmic surgery. Although it was contrary to policies, a good deal of definitive and important ophthalmic surgery was performed in evacuation hospitals by officers of this caliber. The result was, as pointed out elsewhere (p. 77), that enucleations were sometimes performed without implants into the orbit, primary suture of the eyelids was not always carried out, innumerable attempts were made to remove foreign bodies without roentgenologic localization, and even elective muscle surgery was done. In the Seventh U. S. Army, where a part-time, unofficial consultant in ophthalmology functioned, these errors were not made. Experience showed that it would have been a wiser policy to staff evacuation hospitals with the best ophthalmologic talent available rather than to concentrate it in the communications zone, where, when the casualty was eventually received, there was not a great deal that even the most experienced ophthalmologist could do for him. The senior consultant in ophthalmology had no direct authority in the army area and could do nothing to alter the undesirable situation described other than to advise army surgeons and their surgical consultants and to report matters to the Theater Chief Surgeon for necessary command action.

Optometrists

In more than 90 percent of the general and station hospitals, one or more optometrists were assigned to the eye clinic, which was always severely handicapped if such an assignment had not been made. These men were of great technical assistance to the ophthalmologist. They carried out refractions under his direction and were responsible for the adjustment of spectacles and of lenses inserted in gas masks. If the officer in charge of the eye clinic was also responsible for ear, nose, and throat work, the optometrist frequently carried out a major portion of the eye work in the clinic, though this was not a desirable situation.

Optometrists showed great ingenuity in compensating for shortages of equipment by designing and making substitute items, which proved very useful. As time went on, they, like other specialized personnel, began to be in short supply. Efforts made to identify them throughout various units met with some success, and, where it was indicated and feasible, they were withdrawn from whatever nonspecialized positions they were occupying and were assigned to hospitals in which their previous training could be utilized.

Opticians

Opticians also proved useful in eye clinics in the enormous task of fitting and adjusting spectacles and in the large amount of desk work, especially the copying of prescriptions, which forms part of the routine of a busy eye clinic. When a clinic did not have an optician on its staff, every attempt was made to find one who could be withdrawn from a nonspecialized position and utilized in this specialized capacity. Frequently, in clinics in which optometrists were not assigned or in which the work was too heavy for the assigned specialized personnel, the optician was taught to do refractions under the supervision of the medical officer. On-the-job training of both optometrists and opticians proved surprisingly successful in meeting specialized needs.

Nurses

The assignment to the eye clinic of a nurse trained in ophthalmology greatly increased its efficiency. In the operating rooms, less difficulty was experienced, because rotation of nurses was not the rule in them, but on the wards the custom in numerous hospitals of rotating nursing personnel frequently created difficulties in the care of ophthalmologic patients. In the absence of a specially trained nurse, enlisted personnel assigned to the clinic were frequently trained to handle some of the routine work, especially clerical. They also assisted the medical officer in minor technical matters, but, no matter how competent they became, they never fully compensated for the lack of experienced nurses. The delicate instruments used in ophthalmologic work require the most exacting care, which cannot be learned under pressure and within brief periods of time.

FACILITIES

Utilization of Space

Eye clinics in general hospitals, station hospitals, and dispensaries were more or less of the same general pattern, both in the United Kingdom and on the Continent. If the hospital was housed in buildings, the ophthalmologic and otolaryngologic services generally shared a building, which sometimes was a nissen hut. When the hospital was under canvas, a double tent was usually reserved for these services. The physical setup depended on the preferences and planning ability of the officer in charge of the eye clinic, and it was usually possible to secure a fair estimate of his administrative capacities by his utilization of the space assigned to him.

Ophthalmologic inpatients were usually cared for in wards shared with otolaryngologic patients, the two groups, however, being separated. In occasional installations, ophthalmologic patients were cared for in separate wards; this was always more desirable, because it permitted closer control of nursing care and treatment with specialized equipment by the medical officer in charge.

Operations were sometimes performed in the general operating room, sometimes in a room in the operating suite reserved for ophthalmology, and sometimes in space provided for this purpose in the clinic. Operations in the clinic were desirable, in one respect, in that they permitted complete control by the ophthalmologist, but they had the disadvantages of limiting the supply of instruments to those provided for ophthalmic surgery, whereas instruments from the main operating suite could often have been used to advantage.

Equipment and Instruments

In the early days of the European theater, the supply of special instruments was barely sufficient to carry out routine ophthalmologic work in the six general hospitals then functioning. None of the equipment sent from the Zone of Interior in the fall of 1942 was even opened in the United Kingdom, all of it being transshipped to the Mediterranean area for use in the North African invasion.

The immediate problem of supplies was solved by the Theater Chief Surgeon, who was able to obtain 12 complete sets of ophthalmologic instruments and heavy equipment from British sources, through reverse lend-lease. Distribution to the general and station hospitals functioning in the United Kingdom was at first more or less piecemeal and haphazard, partly because most of the equipment was nonstandard and partly because members of supply depots were not familiar with ophthalmologic materials. As time passed, the maldistributed pieces of equipment were located and redistributed. Eventually material began to be received from the Zone of Interior, and hospitals could be supplied with standard equipment.

Certain instruments and equipment, however, were always difficult to obtain or were in short supply. At no time, in spite of repeated recommendations, was a perimeter, which is an essential instrument of diagnosis, made a part of the table of basic equipment. The lack was keenly felt until some ingenious individual discovered that the arc of a bicycle rim had the exact measurements of the arc of the ordinary perimeter at a distance of 33 cm. Thereafter, numerous perimeters were constructed out of the rims of old and wrecked bicycles (fig. 8).

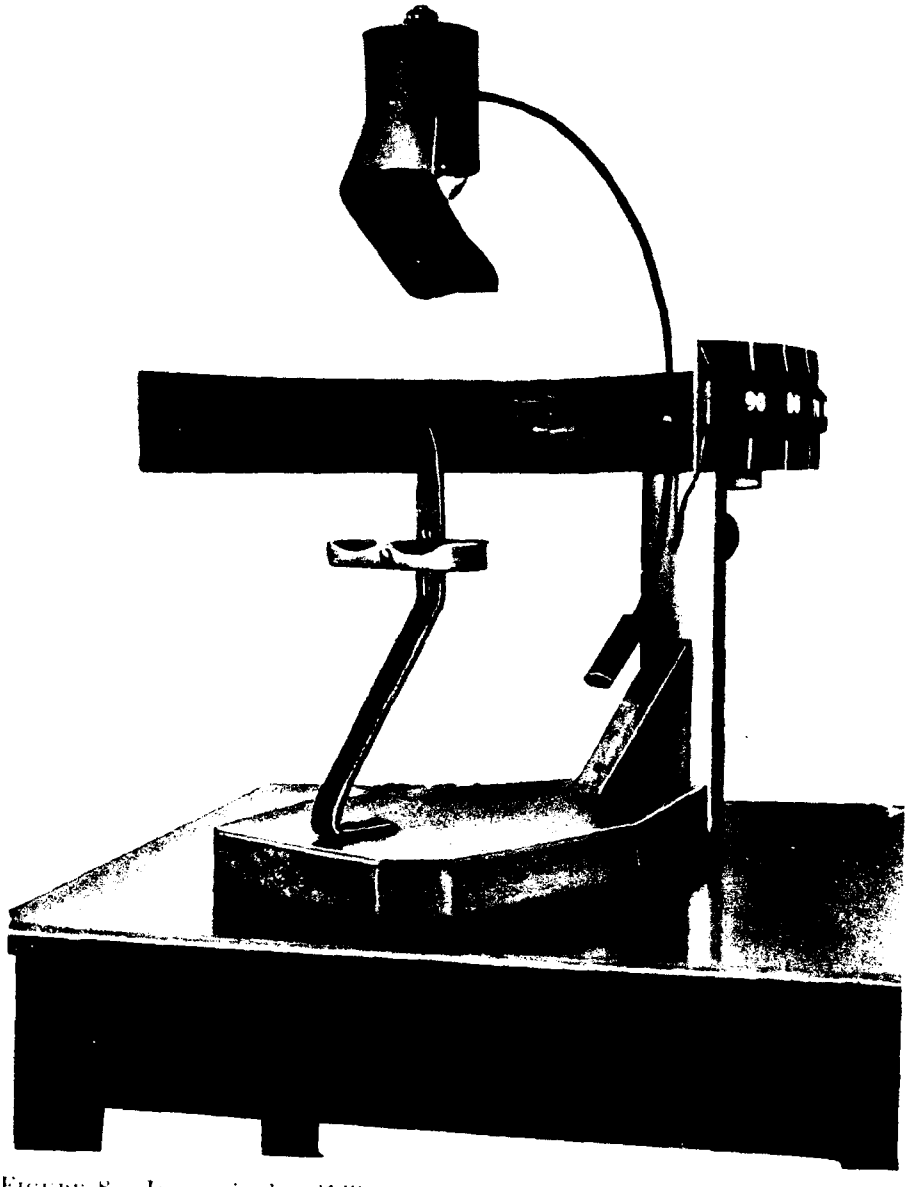


FIGURE 8. Improvised, self-illuminated perimeter made from bicycle rims for use in ophthalmologic clinics in European Theater of Operations.

Bjerrum screens for scotometry were also never placed on the tables of equipment of hospital installations, although they too are necessary ophthalmologic equipment. Blackout cloth or black felt was used for makeshift screens (fig. 9), and test objects were manufactured out of wires with pounded ends, in which colored and white objects of suitable diameters were inserted.

In the fall of 1942, permission was obtained to place an order for British-made slit lamps and corneal microscopes, which were lacking in United States equipment. Delivery was very slow, however, and it was not until 1943 that 12 slit lamps were secured. Distributed to strategic locations in which they could be used for the largest troop concentrations, they served until after D-day. After that date, over an 8-month period, 39 slit lamps of United States manufacture were received and distributed, and a few others became available from captured German stocks. It would have been desirable to have had a less complex and more rugged type of slit lamp for field use, but for hospitals in the rear the type supplied was quite satisfactory.

Until the late summer of 1943, there was a great scarcity of diathermy equipment for the management of retinal detachments. The deficit was then met by an arrangement with a London firm, which supplied the equipment on call to any hospital which required the service. Branch offices in several of the larger cities made it possible to meet requests from all hospitals in the United Kingdom within a few hours of the receipt of the call.

Hand magnets were also scarce initially, and the need was met by the *utilization of British mobile magnets on requisition.* Twenty giant (Solus) magnets of British manufacture had been requisitioned under reverse lend-lease, but priority calls from the British Army and from Russia delayed their delivery. By the late summer of 1943, 12 had been received and distributed, and the remainder were received over the next 6 months. Considerable ingenuity was displayed in the mounting of the British magnet on a carriage (figs. 10 and 11). In the meantime, Lancaster hand magnets had begun to arrive from the Zone of Interior, and before D-day every hospital installation in the United Kingdom was supplied either with this model, which proved extremely satisfactory, or with a British giant magnet. Experimental tests conducted in several hospitals showed that the Lancaster magnet was approximately equal in power to the large and rather unwieldy British giant magnet.

A hammer-type ophthalmologic lamp was greatly needed but never supplied. The lack was overcome by ingenious improvisations.

Early in the war, the British had developed an exceedingly useful item of ophthalmologic equipment described as a portable refraction set. It consisted of the equipment necessary for the performance of fields-of-vision tests, refractions, and external and internal eye examinations. With the wooden box in which it was packed, the weight of this item was about 75 pounds, which made it possible to transport it with little difficulty. The set was particularly useful for evacuation and mobile hospitals and for the performance of emergency refractions, such as were required when WAAC personnel were reinducted as



FIGURE 9. Improvised Bjerrum screen used in ophthalmologic clinics in European Theater of Operations.



[illegible]

WAC's and eyeslip examinations were necessary. Seventy-seven of these sets were obtained from the British and were distributed, as rapidly as they were received, to dispensaries, station hospitals, and, particularly, to Army



FIGURE 11.—Giant eye tractor in use on Japanese front.

evacuation hospitals. The specifications for the portable refracting set, with illustrations, were sent to the Surgeon General's Office in 1943, with the request that a similar set be devised for United States Army use, but the war had ended before this item was ready for standardization.

The trial frames supplied for use by the United States Army were found to be too weak for hard usage, and breakage was frequent. Repairs took an intolerably long time, and it was necessary to requisition frames in large enough numbers to provide for delays while broken frames were being repaired.

The supply of drugs and medications provided for ophthalmologic use was always excellent. Some items seemed unnecessary, but even these occasionally proved useful. As experience developed, the table of basic equipment was revised in this respect, with benefit from the standpoint of efficiency and of financial savings.

Care and repair of instruments. The care of delicate ophthalmologic instruments was extremely important. They were, as a rule, kept separate from other equipment, a precaution which was essential because of their delicacy. On receipt overseas, many of the instruments, particularly knives and scissors, were in deplorable condition because of careless packing, due chiefly to the ignorance of the average supply clerk concerning the careful handling such

instruments require. Repeated requests that sharp instruments be properly protected and packed in strong containers eventually bore fruit, and, toward the end of the war, these items began to be received in much better condition.

The repair of delicate eye instruments presented a difficult problem. Attempts to have one of the medical-depot companies train personnel to repair and sharpen them never proved satisfactory, which was scarcely surprising, as this is a difficult art. Arrangements were made with one of the large ophthalmic-instrument houses in London to handle the work, but because of administrative and other difficulties, the plan was not carried out. The base optical shop in the European Theater of Operations was of some assistance in making minor repairs on such equipment as ophthalmoscopes, but the problem of sharpening ophthalmologic instruments was still unsolved at the end of the war, and the extra supplies which had had to be necessitated for replacement of dull instruments represented considerable waste.

TRAINING IN OPHTHALMOLOGY

General Lectures

The senior consultant in ophthalmology gave lectures in ophthalmology to flight surgeons at the headquarters of the Eighth Air Force, High Wycombe; to the ophthalmologists and otolaryngologists of the First and Third U. S. Armies and three auxiliary surgical groups and to individual units, such as the 77th Evacuation Hospital and the 7th and 12th Evacuation Hospitals. Lectures on nursing care in ophthalmology were also given to nurses stationed at the Field Officers Training School at Shrivenham. In addition to these special lectures, monthly lectures were given at the Shrivenham Training School. By these means, general policies concerning emergency care in ocular injuries could be brought before both specialists and medical officers (general duty), so that specialists could coordinate policies and general-service medical officers would know the general principles of the care of eye casualties.

In May 1945, the Medical Field Service School was reestablished near Paris, and lectures on military ophthalmology were made part of the course, which was participated in by nurses as well as general medical officers. Lectures to nurses placed particular emphasis on the nursing problems of newly blinded servicemen. Lectures and demonstrations designed for medical officers placed particular emphasis upon the necessity for careful handling of all patients with eye injuries, especially perforating wounds of the globe, and warned against the performance of ophthalmic surgery in forward hospitals by officers not trained in the specialty. Otherwise, the lectures were along the same lines as those given in the United Kingdom. They elaborated on the contents of the Manual of Therapy [2] and included such subjects as the treatment of

[2] Manual of Therapy, European Theater of Operations, 5 May 1944.

perforating wounds, the care of prolapsed intraocular contents, the extraction of foreign bodies, the use of tarsorrhaphy, the treatment of burns and gas injuries, and the technique of conjunctival flap and of enucleation.

Practical Training in British Hospitals

When the European Theater of Operations was established, the facilities of the large British eye hospitals, particularly those in London, were placed at the disposal of United States Army ophthalmologists, and the plan was instituted of assigning two officers at a time for periods of 2 weeks to the Royal London Ophthalmic Hospital in Moorfields and to other installations. As the theater load increased, it became more and more difficult to permit these assignments, and after D-day it became impossible. Following V–E Day, an attempt was made to put the plan into operation again, but rapid changes in assignment because of redeployment made it impractical.

Special Courses

At the end of the war in Europe, the senior consultant in ophthalmology, then Lt. Col. James N. Greear, Jr., MC, arranged with Prof. Ida Mann, of Oxford University, for an organized course of lectures for ophthalmologic medical officers who might be held over in the European theater.[3] Distinguished ophthalmologists in the United Kingdom agreed to participate. Arrangements were made for the course to extend from 17 July to 13 August 1945, and to be attended by 40 ophthalmologic officers from various units. Problems of redeployment and changing assignments, however, permitted only 22 officers to report for the course, and the attrition of even this group was so great that only 8 were successful in completing the work.

The course included approximately 88 hours of lectures. Of particular interest and importance were the lectures and demonstrations on embryology of the eye and congenital ocular anomalies given by Prof. Ida Mann; on anatomy of the eye, by Dr. Alice Carleton; on the use of the slit lamp, by Professor Mann; on military plastic surgery, by Maj. Byron Smith, MC, United States Army; on operative surgery, by Mr. Edward F. King; on physiologic optics, by Mr. Charles F. Goulden; on neurologic conditions involving the eye, by Mr. W. C. J. Williams; on detachment of the retina, by Maj. D. C. Shapland, who had recently replaced Sir Stewart Duke-Elder as senior consultant in ophthalmology in the Royal Army Medical Corps; and on perimetry, by Mr. H. M. Traquair.

Except for disappointment in the attendance, which was inevitable because of the time at which the course was given, the series of lectures and demonstrations proved to be a great success, serving not only as a refresher course but also as a reintroduction to academic ophthalmology. The original

[3] Report, Maj. F. P. Calhoun to senior consultant in ophthalmology, Theater Service Forces, European Theater, 4 Nov. 1945, subject: Course of Instruction in Ophthalmology.

plan that, after the formal course, small groups of officers should do clinical work in special clinics in London, Oxford, Birmingham, Leeds, Manchester, Edinburgh, and Glasgow, did not prove feasible under the circumstances.

PROFESSIONAL MEETINGS

In June 1943, as the result of the efforts of Capt. Eugene W. Anthony, MC, of the 52d General Hospital, and Maj. Don Marshall, MC, of the 298th General Hospital, ophthalmologic medical officers stationed in Great Britian formed an organization, the ETOUSA Ophthalmology Society, the purpose of which was to disseminate policies of professional care, pertinent directives, and methods of solution of ophthalmologic-military problems, as well as to exchange professional views on other related subjects. The first meeting of this society which was held at the same time that the Oxford Congress of Ophthalmology (British) was in session, was attended by 29 ophthalmologic Medical Corps officers. At the second meeting, held 18 September 1943, at the 5th General Hospital in Salisbury, 39 were in attendance, and at the third meeting, held 13 November 1943, at an Air Force headquarters near London, 95 were present.

The meetings of the society were of great value. They provided a forum for the exchange of ideas and opinions; stimulated scientific interest in ophthalmology; and, most important at this special time, furnished officers of newly arrived units with information concerning the professional care of the soldier. "Housekeeping" difficulties and the impossibility of handling in wartime England an increasingly large number of medical officers made it impractical to continue the society according to the original plan, and regional meetings were substituted for the general meetings. These meetings were held at irregular intervals in the base sections, at first in the United Kingdom and later on the Continent as well. The first regional meeting, attended by 27 ophthalmologic Medical Corps officers, was held in the Southern Base Section at Salisbury, on 17 April 1944. The second was held in the Western Base Section at Whitchurch, on 20 April 1944, with 29 in attendance.

Members of the society sponsored the ETOUSA Journal of Ophthalmology, issues of which appeared in July, September, and November 1943. This small mimeographed publication was extremely useful, and it was greatly regretted when the pressure of work in the theater and the difficulties of publication forced its discontinuance. It contained lists of recent directives and circular letters, reports of new methods of treatment, suggestions for improvisations to take the place of deficient or missing equipment, scientific notes, and other information along the same lines. After it was discontinued, occasional notes on opthalmology appeared in the Medical Bulletin of the ETO.

Frequent conferences were held between the senior consultant in ophthalmology and the consultants of the various base sections at geographically convenient locations. After D-day, the regional consultants met with each

other, and, on occasion, with the senior consultant in ophthalmology to discuss broad policies of ophthalmologic care and to iron out difficulties. The same system was put into effect on the Continent as soon as possible. As the war progressed, the load of work necessarily reduced the number of these meetings, which, however, grew in importance as their number decreased.

British specialty societies generously extended all their facilities to ophthalmologists in the United States Army Medical Corps, and it was possible for many of them to attend the annual and other meetings of the Ophthalmological Society of the United Kingdom, the Oxford Congress of Ophthalmology, and the Section on Ophthalmology of the Royal Society of Medicine. Every effort was made to liberalize policies, so that as many officers as possible could attend these meetings. In addition to the scientific stimulus thus secured, the exchange of views was productive of much good will between the Allies.

In Europe, it was possible for many ophthalmologists in the Medical Corps to attend the meetings of the ophthalmologic societies of Paris and Liége. Ophthalmologic officers of the Allied armies were always invited to attend meetings of the United States Army ophthalmologists in the United Kingdom and on the Continent.

CARE OF BLINDED CASUALTIES

The original plan for the management of United States Army blinded casualties in the European Theater of Operations was that they should be sent to St. Dunstan's Institute for the Blind, in England, for a period of training before evacuation to the Zone of Interior. This was a British institution founded in World War I to train service-blinded casualties. It began modestly and developed into a well-run and extremely useful organization which continued, during the years of peace, to look after the interests of its former patients. Privately endowed, it was always a popular cause and attracted sufficient funds to permit it to function on a quality basis. At the outbreak of World War II, it was ready to receive British blinded casualties, all of whom received their initial training there. Its direction by Sir Ian Fraser, M. P., who had himself been blinded in World War I, its competent teaching staff, and its fine understanding of the problems of training the blind made it an ideal institution to receive war-blinded casualties.

In the late summer of 1942, Sir Ian Fraser visited the United States Secretary of War and offered the facilities of the institution to United States military casualties blinded in the European theater and awaiting evacuation to the Zone of Interior. The Secretary regarded the suggestion as sound and requested that the Chief Surgeon of the European theater determine the feasibility of the temporary use of St. Dunstan's for the care and training of servicemen blinded in that theater. The senior consultant in ophthalmology investigated the institution, which was then temporarily located at Church

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Stretton, about 12 miles south of Shrewsbury, and reported that he personally was greatly impressed with the organization, equipment, and training facilities. The Theater Chief Surgeon then directed that all blinded servicemen would be sent there for a period of training before their evacuation to the Zone of Interior.[4]

The first United States Army blinded casualty, who had lost both eyes in air combat 2 October 1942, was admitted to St. Dunstan's 20 December 1942. He received every kindness and was given advantage of all facilities, but the experience was not entirely successful, because of difficulties of military housekeeping and because he felt too far removed from his associates. Arrangements were then made with the American Red Cross to detail a worker to St. Dunstan's to look after the personal interests of blinded United States servicemen to be assigned to it in the future. In all, about 15 men were trained there, with more or less satisfactory results, before a comprehensive program for the rehabilitation and training of the blind had been established in the United States.

The directive that these casualties be sent to St. Dunstan's was not adequately obeyed, and blinded soldiers were in most instances sent directly to the United States after spending more or less long periods of time in general hospitals. The great lesson of the St. Dunstan's experience was the demonstration of the value of having a freshly handicapped soldier begin his training under the tutelage of a casualty who had himself suffered the same loss (fig. 12).

On 24 September 1944, Circular Letter No. 115 was issued in the European theater directing that all United States Army personnel temporarily or permanently blinded in both eyes as the result of injury or disease should be evacuated to the Zone of Interior as soon as they became transportable.[5] This letter, like the earlier directive providing that such casualties be sent to St. Dunstan's, was not consistently followed, and blinded men were at times held unnecessarily long in hospitals in the European theater before being sent to the Zone of Interior. Part of the difficulty was due to misunderstanding and part to inertia. The chief difficulty, however, was in the distribution of the directive, which had not reached all ophthalmologic medical officers. It was therefore not at all unusual for the senior consultant in ophthalmology, during his tours of hospital wards, to find blinded soldiers who could quite as well and from the standpoint of their own interests could better be treated in a hospital or center for the blinded in the Zone of Interior. In all such cases, the senior consultant instructed the ophthalmologic medical officer to follow the provisions of Circular No. 115, of which he was almost invariably found to be uninformed.

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[4] Circular Letter No. 80, Office of the Chief Surgeon, Headquarters, European Theater of Operations, 10 June 1944, subject: Policies and Procedures Governing Care of Patients in European Theater of Operations.

[5] Circular Letter No. 115, Office of the Chief Surgeon, Headquarters, European Theater of Operations, 24 Sept. 1944, subject: Disposition of U. S. War Blinded in the European Theater of Operations.



[illegible]

THE ONE-EYED SOLDIER

The soldier who had lost an eye overseas, either from disease or from [illegible] presented a difficult problem. Before D-day, the policy was that a serviceman whose eye had been removed overseas would be returned to the Zone of Interior. On the other hand, the arrival in the theater at this time of many soldiers who had been reduced to the Army limit of only one eye naturally [illegible] this policy. A new policy, that a soldier who had lost an eye would be retained in the theater if his services could be utilized, was therefore established.

The basic depression produced by a soldier who had lost an eye was very [illegible] difficult to overcome. The most common types of emotional reactions were social anxiety, anxiety over dependents, self-pity, and minor emotional maladjustments. The most dominant attitude was the fear of future injury, particularly to the remaining eye. A soldier who had lost an eye in combat was often resentful at being ordered to a replacement center for limited service activities, particularly if he considered his new assignment to be beneath the level of his ability. Accordingly, every effort was made to place men in a position commensurate with his education, training, and interest, so that he would be useful and reasonably well satisfied. Above all, as much

assurance as possible was given to the soldier that he would not again be placed in a position of danger to his remaining eye. Careful personal analysis of individual problems and difficulties went a long way toward creating a normal attitude, but assurances were not always effective, and certain individuals regularly made their appearance at sick call with emotionally caused complaints. In these and other instances in which soldiers who had lost an eye did not make a satisfactory adjustment, they were returned to the Zone of Interior by a physical-reevaluation board.

The great morale value of prompt provision of an artificial eye after removal of an injured eye cannot be exaggerated. This measure, more than any other single measure, alleviated the psychic shock which the injured man had sustained.

COLLECTION OF PATHOLOGIC MATERIAL

From October 1942 until the end of hostilities, the collection of pathologic material was encouraged, and on the whole the system of collection and preserving the material and shipping it to the Army Medical Museum in the Zone of Interior functioned well. Though for sentimental reasons—since so many persons look on the removal of eyes after death with a little more horror than they look on the removal of other organs—directives could not be issued to this effect, it was usually possible, through cooperation of commanding officers of various hospital units, to remove the eyes at autopsy whenever this was desirable. During the year 1944, 91 eyes were thus collected and sent to the Army Medical Museum for section and study, and a similarly large number was secured in 1945. Much valuable information was obtained from study of these specimens.

A circular letter was prepared 7 December 1944, outlining methods of collecting and preserving the specimens.[6] Provision was made that the ophthalmologic medical officer should obtain the eye, wrap it in cotton soaked in formalin, and send it in a container to the First General Medical Laboratory at Salisbury, whence it was dispatched as soon as possible, preferably by air, to the Army Medical Museum in Washington. The circular letter which had been prepared was never put into effect, which was unfortunate, as specimens incorrectly collected and preserved were usually useless.

THE ARTIFICIAL-EYE PROGRAM

Late in November 1942, it became evident that there would be a severe shortage of glass artificial eyes in the United Kingdom. Word had been received from the Zone of Interior that 500 glass eyes had been ordered from a Swiss firm for use in the theater, but it was obvious that this stock would be

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[6] Circular Letter No. 1, Office of the Chief Surgeon, Headquarters, European Theater of Operations, 1 Jan. 1945, sec. III, subject: Preservation and Disposition of Ophthalmic Pathologic Material.

inadequate. The experience of World War I indicated that 2 percent of all casualties would require artificial eyes, and the British found it necessary in that war to have a supply of 88,000 artificial eyes, of which 20,000 were used.[7]

The Theater Chief Surgeon, Brig. Gen. (later Maj. Gen.) Paul R. Hawley, was informed of these facts in a letter addressed to him by the senior consultant in ophthalmology 6 January 1943. In this letter, Colonel Vail also informed General Hawley that one or two firms in the United States were already manufacturing plastic eyes and, in line with Brigadier Duke-Elder's suggestion, stated that British technicians, once they were taught the method, could probably turn out these plastic eyes in large numbers. General Hawley concurred and directed that a letter embodying these facts be prepared for the attention of The Surgeon General.

The problem, however, was solved in the European theater when Lt. (later Capt.) Stanley F. Erpf, DC, working with Capt. Sidney J. Karash, MC, at the 30th General Hospital, developed a method of fabricating an artificial eye of synthetic resin. This process considerably minimized the usual period of delay between the measurement of the patient for a prosthesis and the actual fitting of the finished eye. The simplicity and effectiveness of the method were so striking that these officers were requested to send a preliminary report of their work to the Theater Chief Surgeon. This was done 5 October 1943. Later in the month, the senior consultant in ophthalmology, who had returned to the United States on a brief mission, presented to the Dental Division, Office of the Surgeon General, the method developed by Lieutenant Erpf and Captain Karash.

A request to the Dental Division was submitted through the Chief Surgeon, European Theater of Operations, for the establishment of a course at the 30th General Hospital, under the direction of Lieutenant Erpf and Captain Karash to train as many dental officers as possible in the making of artificial eyes by the new method. This course, which lasted 14 days, was established 24 January 1944. It was limited to dental officers who had done prosthetic work with acrylic. Only 4 officers were trained in the first course, but, as experience developed, it became possible to train an average of 10 at a time. Before D-day, a dental officer trained in the making of acrylic eyes was working in each of the 13 general hospitals in the theater, and, by 1 December 1944, 56 general hospitals in the United Kingdom and 22 on the Continent were thus staffed. It was found that it was not possible to utilize the services of these officers properly in transit hospitals, and those who had originally been attached to them were detached and assigned to hospital centers.

Before the program for the making of acrylic eyes got under way, a search had been made among enlisted men in the European theater for experienced fabricators of artificial eyes. None could be found. It was therefore necessary to use the facilities kindly placed at the disposal of the United States Army by

[7] Memorandum, Lt. Col. D. T. Vail, MC, for Chief Surgeon, European Theater of Operations, United States Army, 6 Jan. 1943

the British. The arrangement did not prove satisfactory. British facilities were meager, and a period of 2 to 3 months elapsed from the time of the appointment for the making of the eye to the delivery of the finished product. Fitting could be only by appointment, and delays of 4 to 6 weeks for this purpose alone were not uncommon. When the acrylic-eye program was once operating efficiently, the period from enucleation to the fitting of the finished prosthesis averaged only 2 weeks.

When The Surgeon General visited the theater in the early spring of 1944, he was so impressed with the program that he initiated a similar training program in the Zone of Interior (p. 35).

In an occasional case (not more than four in the whole theater), the eye socket was irritated by the acrylic prosthesis, and an allergic conjunctivitis resulted. In one instance, tests showed that the offending substance was the liquid acrylic monomer and not the acrylic powder. In all of these cases, the patients were able to wear glass eyes successfully.

THE OPTICAL PROGRAM

Base Optical Shop [8]

For some time after the establishment of the European Theater of Operations, glasses prescribed by medical ophthalmologic officers were supplied on contract by several optical firms in London, as arranged by the Theater Chief Surgeon. The arrangement proved adequate until troops began to arrive in the theater in greater numbers. Then delays began to occur, and, by October 1942, a period of 6 to 8 weeks was elapsing between the presentation of the prescription and the delivery of the finished product. Not much could be done to remedy the situation from the angle of the British opticians, who were overwhelmed with the task of supplying the British forces all over the world as well as in the United Kingdom, and who also had to care for civilian needs.

A single mobile optical unit was sent from the Zone of Interior, but it never functioned, and in October 1942 it was shipped to the North African theater, without its personnel.

Since the situation in regard to the supply of spectacles for the United States Army was rapidly becoming chaotic, arrangements were made with the British Ministry of Pensions for use by United States personnel of the facilities and supplies of its optical department at Norcross, near Blackpool. The original permission was for a period of 3 months, beginning 1 January 1943, but the European Theater of Operations Base Optical Shop, as the unit came to be known, remained active under this arrangement until 1945. The relationship between the British workers and the officer and seven (originally eight) enlisted men who comprised the personnel of the unit was always one of great

[8] (1) Base Optical Shop Status Report on Equipment and Supplies by Capt. C. E. Rorie, 9 Sept. 1944. (2) Letter, Capt. Chester E. Rorie to Dr. Derrick T. Vail, 3 Apr. 1946, subject: Report of Optical Program, ETO.

cordiality and friendly cooperation, and there is no doubt that the comradeship between the Allies played its part in the highly efficient work of the unit.

A London optical house (Hamblin) continued to be utilized under contract to supply complicated lenses, including bifocal lenses and special types of frames. To facilitate the work, particularly the distribution of the finished product, one of the enlisted men from the Norcross installation was detailed to the Hamblin plant in London, where he remained until after V–E Day. As the result of his efficiency and the excellent cooperation of the firm, a large volume of special work was handled expeditiously throughout the war.

The status of the European Theater of Operations Base Optical Shop was always in doubt, as no table of organization for the activation of a specific base optical unit was ever received. There were frequent changes of the enlisted personnel, which was made up of men from various medical depot company optical sections ordered to the station on detached service, but the same commanding officer was in charge throughout the war.

In November 1944, a section of the base optical shop was moved by air to Paris to supply troops in combat on the Continent. Its functioning was delayed by certain tactical and other considerations. Electricity was not available during the day, owing to the fuel shortage, and movement of the personnel at night was difficult later, owing to the curfew imposed because of the Battle of the Bulge. Some of the planes carrying supplies had to be diverted to airstrips other than those of their original destination. Requisitions were confused because of impairment of communications, and a tendency to overorder was evident in requests from the field. Within a short time, however, the same routine of prompt service was established which had been in effect for many months in the United Kingdom.

The importance of the base optical unit is evident from the amount of work it performed. When it was first established at Norcross, the spectacle requirement was less than 300 pairs per month. In May 1944, 15,000 requisitions were processed and during the remainder of the war the work level continued at about 12,000 pairs per month.

Constant efforts were made to reduce the time between the receipt of the prescription and the delivery of the finished product. Within a few weeks after the unit had begun to operate, this period was reduced to 3 or 4 days and in many instances on the Continent, when speed was essential, it was only a few hours. On one occasion, prescriptions for 27 pairs of spectacles and gas-mask inserts were filled within 3 hours.

In addition to processing spectacles, the base optical shop at Norcross received, stored, and issued all optical supplies for the theater, including supplies for the base optical shop established in Paris in November 1944. It received, stored, and issued glass artificial eyes; received, processed, and issued mobile and portable optical units; computed levels and determined operating procedures; oriented, and sometimes trained, personnel for Army optical work; and repaired some ophthalmic instruments.

Redeployment introduced new problems. The original plan was to deploy approximately 2 million troops as promptly as possible, with all men with visual error equipped with their maximum spectacle requirements; that is, two pairs for ordinary use, plus one pair of gas-mask inserts for those with visual acuity of less than 20/70. Since, however, service troops, in which category optical units belonged, were among those scheduled for early deployment, approximately two-thirds of all optical facilities ceased operation at just the time that requirements were 20 percent or more higher than they had ever been and when most requests (for mobile units and spectacles alike) were marked for immediate action.

The problem was solved in several ways: Prisoner-of-war stockades were screened for experienced opticians, and between 50 and 75 were thus located and were assigned to various optical units. A 24-hour shift was set up in one of the assembly areas, and additional equipment was provided for it. Stocks of supplies were distributed to all optical units in which the demand was heavy. Civilian opticians were employed in Paris and in Liége. Portable units, mounted by two's in small-arms ordnance repair trucks, were sent to Bremen and to Berlin. By these means, it was possible in the last month before V–J Day, when demands automatically ceased, to process and deliver some 37,000 pairs of spectacles in the European Theater of Operations.

Mobile Optical Units

The original equipment available in the European Theater of Operations for the processing and repairing of spectacles was the single optical unit which, as noted, was sent to the North African theater in the fall of 1942. By D-day, 5 others had reached the theater, 1 of which was necessarily retained to equip the base optical shop. Up to and including V–E Day, 27 units in all were received and put into operation (figs. 13 and 14).

The first unit received was fitted with equipment of standard commercial design, intended for use inside a building under civilian conditions. Not much attention had been paid to its size or mobility, and delicate precision parts were inadequately protected. This was the equipment which was installed in the space occupied in the British Ministry of Pensions Optical Department in Norcross.

The second mobile optical unit which reached the theater was, according to the tables of equipment, part of a medical-depot company. The depot personnel, realizing the need of protection for such equipment, had enclosed it in an improvised manner. Units received thereafter included adequate protection for precision equipment. All these units were field tested in their ability to fit gas-mask inserts before they were finally issued to field Army depot companies.

Three mobile units of a new design arrived in the United Kingdom D-day plus 30 and were attached to medical-depot companies awaiting this equipment.

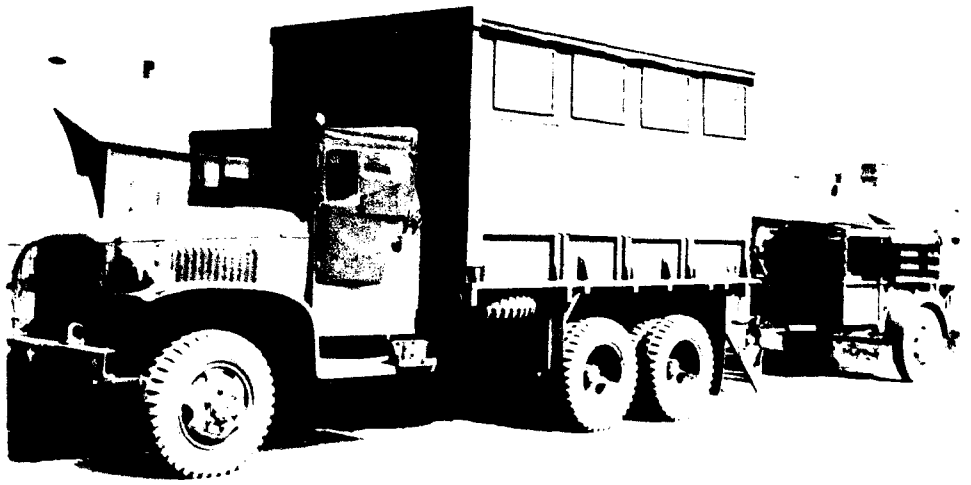


FIGURE 13. Mobile optical truck and trailer set up for use in European Theater of Operations.

The new design proved to have many advantages over the older model. The vehicle was an enclosed type, of larger area, with the equipment mounted on built-in benches and so arranged that it could be used efficiently in the truck or, as often proved more desirable, could be removed from the truck and set up under canvas or in buildings.

After February 1944, as the result of requests from the theater, two spindle-surfacing units were supplied with each mobile unit. Their receipt and use cut in half the number of requisitions previously forwarded to the civilian contractor.

The experiences of one mobile optical unit in the European campaign may be related as typical. On D-day, a portable unit with an optician was landed on one of the beaches and was joined on D-day plus 4 by a similar unit. On D-day plus 6, enemy action was sufficiently reduced in the area to permit the functioning of both units. Although their production capacity was considerably higher, an average of only 10 jobs a day was completed by each unit, the reason for their relative inactivity being that the troops were ignorant of their location or, in some instances, of their actual existence.

On D-day plus 14, a mobile optical unit was set up and at once began to replace glasses lost during the landings and to repair others which had been broken. In spite of lack of general knowledge on the part of the troops that

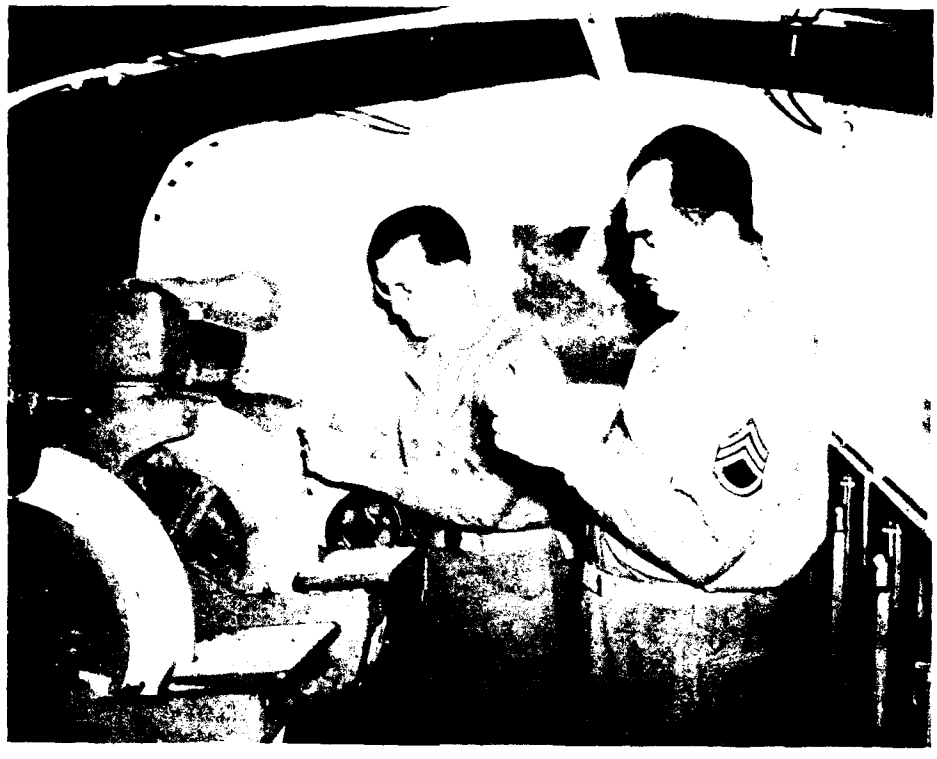


FIGURE 11. Interior of mobile optical truck in use.

such a mobile unit was available, production was at a steady level of more than 100 jobs daily until D-day plus 40. Thereafter, as information concerning the existence and location of the optical units spread, the work level gradually increased.

Portable Optical Units

Portable optical units were designed to furnish facilities for the fabrication and repair of spectacles in forward combat areas. When they were employed in these areas, they were usually attached to divisions. When they were not thus utilized, it was usually because they were not needed. Communications to the rear were good; prescriptions could be taken back at the same time requisitions for medical supplies went back to the army medical depot, where mobile optical units were stationed.

In the first weeks of the campaign on the Continent, only a limited number of portable optical units were available. By February 1945, 54 were in use throughout the theater. These units were more and more widely used as the knowledge of their possible usefulness increased. They were also more widely used when they were provided with their own jeep transportation. When available for use in general hospitals, they were attached to those installations.

Each portable optical unit was provided with two chests containing a limited quantity of uncut lenses, with adequate equipment for their utilization

by one optician and one helper. The calculated daily production capacity of 15 pairs of spectacles (or repairs of spectacles) was often greatly exceeded in times of stress. The edging wheels of the units were hand operated and rather difficult to manipulate. This was really their only defect, and ingenious opticians often overcame it by replacing the hand-operated device with motors designed for other purposes.

Special Problems

Frames and lenses.—When the base optical shop first began to function in the United Kingdom, supplies of spectacle frames and lenses received from the Zone of Interior were entirely inadequate and were supplemented from British sources through reverse lend-lease. The British frames were of poor quality and differed from the United States design in that they were of the round 40-mm. type. The lenses supplied were flat. The soldiers found them unsatisfactory, and they would have been numerically inadequate also except that, just as supplies were diminishing, a stock of frames and round toric 42-mm. lenses of United States manufacture was located in an English supply depot and was turned over to the United States forces.

This unexpected supply solved the problem of gas-mask inserts (p. 116), since the lenses were of the correct size and shape for the insert frame. It was thus possible for the European theater base optical shop to supply for field use round lenses suitable for replacement of gas-mask insert lenses. As more and more United States frames and lenses were received, the use of the British round frames and lenses could be curtailed, though difficulties arose when some soldiers, desiring the more attractive United States type, threw away or broke still serviceable round frames so that they could be replaced by the United States P3 type of frame.

The P3 regulation spectacle frame proved, on the whole, entirely satisfactory. It required expert initial adjusting, but usually, once the adjustments had been made, it stood up well under adverse circumstances.

From the supply point of view, it was not desirable to have two types of lenses, round for the gas-mask insert and oval for the P3 frame. Had chemical warfare been employed by the enemy and rapid replacement of gas-mask inserts proved necessary, it is likely that this difficulty would have been found to be insurmountable, and soldiers dependent on spectacles would have been just as ineffective from poor, uncorrected vision as if they had been gassed or wounded. It would be well, in the future, to adopt a lens which would be suitable for both gas-mask inserts and ordinary spectacle frames.

Minor corrections.—Early in 1943, it became evident that large numbers of prescriptions for minor corrections were being filled. This resulted in waste of material, especially of frames, which were in short supply, as well as of the time and effort of already overburdened optical units. A directive [9]

[9] Circular Letter No. 43, Office of the Chief Surgeon, Headquarters, European Theater of Operations, 25 Mar. 1944, sec. I, subject: Procurement of Spectacles.

was therefore issued which (1) forbade the filling of prescriptions for corrections of less than plus 0.75 or minus 0.50 in the smallest component; (2) forbade increments of less than 0.25 diopter for lens up to and including 4.0 diopters and increments of less than 0.50 diopter for corrections of more than 4.0 diopters; and (3) forbade the provision of tinted glasses under any circumstances, though the individual soldier was permitted to obtain them through civilian supply if he desired. The use of civilian type of rimless glasses was discouraged; they were not provided by the Army, and they were never repaired in the base optical units.

Special lenses.—Special lenses such as bifocals, prism additions, and off foci, were made for key personnel by the civilian contractor. This usually entailed considerable delay, and the individual who needed these items was requested to satisfy his presbyopic requirement by obtaining two pairs of glasses, one for distance and the other for close work. In numerous cases, this completely solved the problem.

Record of prescriptions.—A problem that was not solved throughout the entire campaign in Europe concerned individual prescriptions for spectacles. Again and again, soldiers presented themselves for replacement of their glasses without having suitable copies of their prescriptions and accurate measurements of their frames on their person, in their service records, or on their immunization cards. The omission was particularly troublesome in the fitting of gas-mask inserts, but at all times it delayed the making of lenses and increased the workload carried by ophthalmologic and optical personnel. It is impossible to estimate the number of men who had to have repeated refractions, sometimes within relatively short periods of time, simply because they did not have on their persons copies of their prescriptions.

Numerous plans were devised to overcome this difficulty. Special blanks, provided by the Chief Surgeon, were filled in by the optical units when prescriptions were filled, but it was only the occasional individual who kept the card. The problem was so acute and the solution so unsatisfactory in World War II that cognizance should be taken of it and a better solution found in the peacetime Army. One proposed plan is that the prescription be written in indelible ink on a small waterproof tag to be attached to the chain on which the identification tags are worn. The suggestion that the copy be impressed on the metal identification tags is less practical, since prescriptions are likely to be changed as time passes.

Gas-Mask Inserts

A great deal of difficulty was encountered in supplying and fitting the spectacles originally used for gas masks, and it was hoped that, when gas-mask inserts were devised, the problem would be simplified. The inserts were far more practical than the spectacles originally used, but, by the fall of 1943, it had become clear that it would be a major task to fit the troops already in the European Theater of Operations and the troops still to arrive.

Before D-day, the senior consultant in ophthalmology, in cooperation with the base optical shop, developed a program of supply, which was carried out satisfactorily and with great efficiency. Each unit surgeon ascertained the number and location of troops in his unit who required gas-mask-lens inserts (that is, all men with vision of 20/70 or less). These data were submitted to, and coordinated by, the senior consultant in ophthalmology, and, from them, suitable locations for centers for fitting gas-mask inserts were determined. An itinerary was then mapped out by which three mobile optical units could cover the entire list of centers. One unit supplied the First U. S. Army troops and the other two units supplied the Army Air Forces; during this movement, these mobile optical units (fig. 15) did no other type of optical work. The remainder of the Ground Forces and Army Service Forces troops were fitted at strategically located general and station hospitals which had been supplied with sets for fitting gas-mask inserts. Over a 6-week period, 7,500 pairs of gas-mask inserts were supplied to the Ground and Air Forces, while during April 1944, when an auxiliary laboratory was equipped for this purpose, the base optical shop processed daily as many as 600 requisitions for gas-mask inserts from various hospitals. As increasing numbers of troops in the United Kingdom were supplied with inserts, the demand began to decrease; by D-day



FIGURE 15.—Fitting gas-mask spectacles on assembly-line basis before D-day in European Theater of Operations.

plus 60, the provision of gas-mask inserts represented not more than 20 percent of the total optical output, and, shortly afterward, requests for them became negligible.

After V-E Day, the task arose of fitting gas-mask inserts for troops to be redeployed. Gas masks had been lost during the closing days of the European hostilities or had been collected without any consideration whether or not they contained inserts. Moreover, there was no possible method of identifying the particular inserts in relation to their owners. As a result, troops to be redeployed to the Pacific theater had to be fitted for the second time with gas-mask inserts, in addition to the refitting and replacement of spectacles. The work was done rapidly, and all troops already redeployed or ready for redeployment at V–J Day were adequately equipped with both gas-mask inserts and spectacles.

Presbyopic requirements introduced a considerable problem in the provision of gas-mask inserts. It was not practical to have a bifocal insert manufactured, and here the solution seemed to be to fit one eye with a reading and the other with a distance glass. Many presbyopic men were willing to wear their reading glasses on top of the gas mask, and, for short periods of time, this plan was quite satisfactory.

Statistical Data

By the end of June 1945, 3 base optical shops, 10 mobile optical-repair units, and 17 portable optical-repair units were functioning in the European Theater of Operations. Approximately 18 percent of the troops in the theater had required glasses, and the average replacement per individual was 3½ pairs.

The final report of Capt. Chester E. Rorie, commanding officer of the European Theater of Operations Base Optical Shop, indicates that 96.93 percent of all prescriptions received by all units were filled with material available in the units. Surface-grinding facilities, available in the units, permitted the completion of another 2.48 percent, representing the more complicated prescriptions; this left only 0.59 percent of the prescriptions to be purchased through civilian sources. In effect, this meant that during the active period of hostilities, 199 of every 200 spectacle-wearing troops received their prescriptions within a few days, and some within a few hours, after they had been requested.

The records of the base optical shop show that, during 1944, 78,395 pairs of spectacles and 23,739 gas-mask inserts, or a total of 102,134 jobs, were processed. This figure does not include the work done in the field, particularly on the Continent, or in the general hospitals in the United Kingdom Base or on the Continent. During the first 6 months of 1945, 186,000 requisitions for spectacles had been processed by the various optical units, 99.3 percent of these being provided from materials immediately available. Eighty-two thousand of the requisitions had been processed by mobile units functioning

in the army areas.[10] Mobile units had completed 102,000 prescriptions, portable units 18,000, and base optical shops 66,000. It is fair to say that, without the work accomplished by these units, approximately 10,000 troops might have been evacuated from the theater each month because they would have been visually unfit for duty.[11]

Conclusions

The experience in the European Theater of Operations makes it clear that an efficient optical supply for troops in the field requires (1) a base optical shop to act as a center for the distribution of optical supplies, for the fabrication and grinding of special types of lenses, for the training of personnel, and for the repair of field equipment; (2) a subsidiary shop housed in a safe area in the forward portion of the communications zone; (3) mobile units for the rear areas of the Army zone; and (4) portable units placed as far forward as possible. Because base optical shops were not activated and operated under an authorized table of organization in the European theater in World War II, plans had to be improvised on a day-to-day basis of uncertainty. Otherwise, errors in the optical program were few and of little consequence.

WORKLOAD

Required Army reports did not supply the senior consultant in ophthalmology with sufficient detail to keep him adequately informed of the workload in the various hospitals, the ophthalmologic needs of the theater, and the quality of the work being done. Regular monthly reports were therefore requested from ophthalmologists in station and general hospitals. Since these reports were not officially required, they were not received from all units, and, because of administrative difficulties, none were received from the last units to arrive in the European theater.

Some indication of the character of lesions cared for and of the military workload can be derived from the combined report of the hospitals which submitted data for 1944 (table 4).

Before D-day, most patients in hospital clinics and wards presented ophthalmologic conditions similar to those encountered in civilian practice except for Air Forces casualties and some casualties filtering in from the North African Theater of Operations. Because of the concentration of airfields in East Anglia, the station hospitals in these areas received the most seriously injured Air Forces casualties, and the policy was instituted of placing the best trained and most widely experienced ophthalmologists in these installations.

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[10] As an example of the work performed by one such unit, during the period 1 January–30 June 1945, the mobile optical unit of the 32d Medical Depot Company, Third U. S. Army, completed 14,179 optical jobs.—J. B. C., Jr.

[11] Semiannual Report for Ophthalmology, 1 January–30 June 1945, European Theater of Operations.

These station hospitals, therefore, performed definitive surgery, which was always of the highest caliber.

After D-day, arrival of battle casualties from the Continent completely changed the ophthalmologic picture in the United Kingdom. For the first few weeks, ophtnalmologists in the busy receiving and transit hospitals in southern England not only carried the responsibilities of their specialty but also assisted in all varieties of surgical work, as the need arose. The policy of handling nontransportable casualties with eye injuries was based on expediency. If a qualified ophthalmic surgeon was located within a reasonable distance of the hospital, his services were requisitioned. If this was not possible, the general surgeon carried out whatever ophthalmologic procedures could not be deferred. It was in these circumstances that the lectures and training in ophthalmology given during the waiting period before D-day to medical officers not trained in the specialty bore its best fruit.

TABLE 4.—*1944 activities of 104 general and 37 station hospitals in the European Theater of Operations*

[These figures are representative but possibly not entirely accurate, since some patients, because they passed through more than one hospital during evacuation, may have been counted more than once]

Clinical condition or operation	Distribution of cases		Total cases
	General hospital	Station hospital	
Enucleations	776	179	955
Glass ball or other orbital implants	504	46	550
Exiscerations	91	31	122
Sympathetic ophthalmia	9	1	10
Intraocular foreign bodies	728	226	954
Successful extraction of intraocular foreign bodies:			
Magnetic	221	21	242
Nonmagnetic	65	23	88
Orbital foreign bodies:			
Incidence	769	279	1,048
Extraction	226	186	412
Perforating injuries (with or without conjunctival flaps)	1,603	357	1,960
Optic-nerve injuries	224	29	253
Fracture of orbital apex	76	58	134
Hemorrhage into nerve sheath	61	3	64
Post mortem specimens obtained	145	6	151

Source: Annual reports, Sections of Ophthalmology, General and Station Hospitals, Office Surgeon, European Theater of Operations, 1944.

CHAPTER VI

Clinical Policies in Ophthalmology, European Theater of Operations

Derrick T. Vail, M. D.

NON-COMBAT-CONNECTED OPHTHALMOLOGIC CONDITIONS

The usual ophthalmologic diseases encountered in civilian practice were observed in the European Theater of Operations in clinics and hospital wards and in general paralleled these conditions as they would be manifest in non-combat areas.[1] One or two impressions gained by the senior consultant in ophthalmology on his frequent hospital visits might, however, be mentioned.

Between the fall of 1942 and July of 1945, a number of cases of keratoconjunctivitis were observed. The condition never reached epidemic proportions, but it was usually stubbornly resistant to therapy. It required long periods of hospitalization for the patients, and in some instances it rendered them unfit for military duty, particularly overseas. The causative agent was assumed to be a virus, though this was never proved.

Keratoconjunctivitis in the European theater resembled in many respects the same disease as it would be encountered in civilian life, except that it tended to occur unilaterally, first in one eye, and then, after subsidence on this side, in the other eye. Treatment was generally unsatisfactory. Pain was almost intractable, regardless of the methods employed, and in a few instances could be controlled only by retrobulbar injections of 40 percent alcohol. In one such case, undoubtedly as the result of a faulty technique of injection, the alcohol entered the optic nerve, and almost complete blindness in the affected eye followed.

So far as is known, primary trachoma was never encountered. In the few instances of the disease which were observed, it was believed, on sound evidence, that the condition had existed before enlistment and was recurrent.

Secondary glaucoma, as the result of disease or injury, was rather frequent, and circumscribed choroiditis was observed with apparently unusual frequency, though no explanation for the impression can be advanced.

[1] A statistical presentation of diseases of the eye in the United States Army during World War II is contained in appendix A, pp. 549–555.

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Not more than half a dozen cases of gonorrheal conjunctivitis were observed. These invariably cleared up rapidly (within a few hours) with the use of local and parenteral therapy with penicillin, and the affected soldiers could be returned to duty within the week. An occasional case of sensitivity to the local use of penicillin was encountered, as were a few instances of sensitivity to the sulfonamide drugs.

Several soldiers became blind as the result of methyl alcohol poisoning, both in the United Kingdom and on the Continent, but the cases were not numerous, for the poisoned individual usually died promptly and did not survive to become blind.

Functional disorders were not unduly frequent. Functional night blindness was not officially recognized, unless it could be accounted for by organic disease. The number of cases of functional amblyopia was relatively large. When the diagnosis was made, the patient was referred to the neuropsychiatrist, and therapy was usually successful.

The number of proved cases of conjunctivitis artifacta was small. Ophthalmologists were on guard against it and generally succeeded in recognizing it before it became a serious problem.

Ocular malingering was not often encountered. Suspected individuals were studied with great care before the diagnosis was made and were given the benefit of every possible doubt. Through careful suggestion and guidance, most soldiers who attempted this deception were made aware that it was recognized and were usually permitted to withdraw gracefully from their position before it became irreversible.

It had been anticipated that the work of the optical units would be heavy just before D-day, because it was expected that numerous soldiers would break or lose their glasses in order to avoid being sent into active combat. Steps were therefore taken to have optical units available at ports of embarkation to handle last-minute emergencies. It is gratifying to be able to report that instances of willful loss or breakage were so occasional as to be negligible. It is also gratifying to report that from D-day on, there was also practically no evidence that glasses were willfully destroyed, damaged, or discarded so that the soldier might be relieved of combat duties pending their replacement.

COMBAT-INCURRED INJURIES

General Considerations

The fundamental policies for the care of ophthalmologic casualties were outlined in the Manual of Therapy, European Theater of Operations,[2] which had been placed in the hands of every medical officer in the theater before D-day. In addition to the directions contained in this manual, which proved

[2] Manual of Therapy, European Theater of Operations, 5 May 1944.

entirely adequate and required no changes of consequence during the course of the war, circular letters were issued from the Chief Surgeon's office from time to time dealing with specific problems as they arose, and with the treatment of special conditions, such as the management of keratoconjunctivitis, the employment of conjunctival flaps, and methods of removal of foreign bodies.

The senior consultant in ophthalmology and the regional consultants who were appointed later considered it an essential part of their duties to give instruction on the ophthalmologic management of the sick and wounded not only to ophthalmologic medical officers but to others, particularly officers assigned to surgical services. The need for instruction of the latter group soon became evident. In tours of inspection, occasional wounded soldiers would be found on general surgical wards, where they belonged because of the nature of their wounds, but who also had injuries of the eyes which had been overlooked. It was therefore essential that the chief of the surgical service in each installation be thoroughly indoctrinated with the concept that every casualty, regardless of the nature of his injuries, must be examined for possible eye injuries.[3]

In the United Kingdom, before the heavy buildup of troops and patients took place, ophthalmologic and other medical officers could be briefed, before their units became operational, concerning the special problems of military ophthalmology. It was often possible to attach an ophthalmologist assigned to a newly arrived unit for a 2-week period to an established unit, where he could receive invaluable instruction as to the military aspects of his duty. When units began to arrive in the European theater in great numbers and, after D-day, when the patient load was heavy, this plan was no longer practical. Instruction was then limited to dissemination of information by the senior consultant in ophthalmology and the regional consultants; the circular letters mentioned, the distribution of which, however, was not always satisfactory (p. 106); and the lectures given by the senior consultant (p. 102).

The understanding was that the principles set forth in the Manual of Therapy were to be followed routinely unless there was sound reason for departing from them in an individual case. "Sound reason" was not interpreted to mean individual preference for another procedure. The general basis for these policies was the military necessity that required the treatment of a single patient by different medical officers at various points in the chain of evacuation. The practical basis was the fact that ophthalmologists were not placed in forward units, which implied that initial treatment in all cases, and definitive treatment in some, had to be administered by medical officers whose knowledge of ophthalmology was limited. Whenever possible, therefore, transportable patients with injuries of and about the eye were promptly evacuated to rear installations in which specialized treatment could be supplied.

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[3] A statistical presentation of injuries of the eye in the United States Army during World War II is contained in appendix A, p. 556.

Initial Management

Medical officers stationed in forward installations to which wounded men were first brought were instructed to examine all patients, particularly all unconscious patients, for possible ocular injuries. Treatment was administered according to the following plan, which permitted a tentative diagnosis:

1. The lids were separated gently, pressure on the eyeball being avoided. Spasm of the lids was overcome by lid hooks or, if these were not available, by the use of a piece of strong wire bent into the shape of a U or the use of the handles of two teaspoons.

2. Superficial loose foreign material, metallic bodies, and dirt were removed. Probing was not permitted, nor was prolapsed tissue excised. Training in first-aid methods for these injuries had included the warning not to mistake prolapsed iris or dark, bloody vitreous for foreign bodies.

3. The instillation of 2 drops of 1- or 2-percent atropine solution was followed by the instillation of 5-percent sulfanilamide ointment, 5-percent sulfathiazole ointment, or 1- or 2-percent yellow oxide of mercury ointment, depending upon which was available.

4. A folded eyepad, moistened in boric acid, physiologic salt solution, or sterile water, was laid over the eyelids. The moistened pad was covered with a dry eyepad or with a 2-inch gauze square fastened in place with adhesive tapes. The sound eye was covered with dry gauze, and a binocular bandage was applied.

5. If the patient was unconscious or if the lids were badly damaged, sutures were placed through the skin and subcutaneous tissue of the upper and lower lids, adjacent to the lash edge, and fastened. An even simpler method was to pass a silk stitch through the skin of the upper lid and then to fasten the free ends of the stitch to the cheek with a piece of adhesive tape after the lid had been drawn down. If the upper lid had been destroyed, the same process could be carried out in reverse on the lower lid. If the lids were split or torn, the sutures could be placed in the intermarginal lid areas.

6. If the lids were hopelessly destroyed but the eyeball was in reasonably good condition, a complete purse-string conjunctival flap was performed (p. 125).

7. All patients with injuries of the eye were evacuated recumbent on litters if this was at all possible. If for any reason this was impossible, the sound eye was covered only by a screen of cardboard or stiff paper with a peephole 2 to 3 mm. in diameter, or by an eyeshade, to help splint the injured eye and at the same time allow limited vision.

Later Treatment in Forward Areas

If the patient for any reason could not be evacuated within 48 hours to an installation where competent ophthalmologic care could be given, the procedure was as follows:

1. Under a good light, and with sterile technique, the eye was gently opened and irrigated with saline or boric acid solution. Obviously superficial and loose foreign bodies as well as superficial corneal foreign bodies were removed, care being taken not to mistake prolapsed vitreous and prolapsed uveal tissue for foreign material. Perforations, ruptures of the globe, and other injuries were carefully sought for.

2. If an injury requiring surgery was found, the eye was anesthetized by instillations of ½ percent Pontocaine, 2 percent Butyn (unless the patient had received one of the sulfonamide drugs), or 4 or 5 percent cocaine. One drop of any of these agents instilled 4 times at 3- to 5-minute intervals provided adequate analgesia for simple or surface ophthalmic surgery. If general anesthesia was desired, Pentothal Sodium (thiopental sodium) was used.

Perforating wounds of the cornea. The first step in the management of a perforating wound of the cornea was excision of the prolapsed iris at the corneal surface, after the prolapsed tissue had been withdrawn slightly from the wound by forceps. After excision, the stump of the iris usually withdrew into the wound by natural elasticity of the tissues.

A small perforating wound near to or involving the limbus could often be treated by partial (apron) conjunctival flap. An incision was made in the conjunctiva at the edge of the limbus in the area of the wound and was continued close to the cornea until from a third to a half of the limbus had been incised. The conjunctiva was undermined by blunt dissection as far back as possible, care being taken to avoid injury to the ocular muscles and to avoid pressure on the eyeball. A single stitch was applied in the undermined conjunctival edge on one side of the area of the corneal wound; the suture was buried under the unaffected cornea for about 5 mm. and then was brought back to the surface, after which it was tied. A similar stitch was applied on the opposite side of the wound. An apron of conjunctiva, the undermined aspect of which was apposed to the cornea, could thus be brought over the corneal wound, for which it served as a splint.

If the perforating corneal wound involved more than half of the cornea, a complete conjunctival flap of the purse-string type was required. A complete conjunctival peritomy was carried out around the corneal limbus, and undermining was performed with the precautions previously noted. A purse-string suture inserted around the cut edge of the conjunctiva was pulled tightly enough for the conjunctiva to cover the cornea completely. The suture was then tied, 2 percent atropine was instilled into the eye, and eyepads were applied (p. 124).

Lacerations (perforations) of the sclera.—Prolapsed uveal tissue was excised close to the sclera. Each cut edge was lifted gently in turn, care being taken to avoid pressure on the eyeball, while a suture of fine silk was applied. The wound was covered by suturing the conjunctiva on one side to the conjunctiva on the other side with a mattress suture.

Lacerations of the ocular muscles.—Lacerated ocular muscles were sutured in proper position with fine silk, after which the lacerated conjunctiva over the area was similarly sutured.

Lacerations of the eyelids.—Lacerations of the eyelids were sutured with fine silk as accurately and closely as possible, with the preservation of as much tissue as possible. A key stitch was first inserted in the intermarginal lid area and was tied firmly, so that it formed a small elevation or teat.

Enucleation and evisceration.—Since sympathetic ophthalmia does not develop for 10 to 14 days after injury, surgeons in the forward area were seldom called on to perform enucleation. When necessary, it was carried out by the following technique:

Following peritomy of the conjunctiva at the limbus, and complete undermining, each ocular muscle was isolated with a strabismus hook and was excised close to the sclera. The stump of the external rectus muscle was firmly grasped, and the eyeball was rotated far to the nasal side. Excision scissors were passed into the orbit between the eyeball and the conjunctiva until the optic nerve, which was felt as a firm, cordlike structure, could be grasped and cut. The eyeball was pulled out, and tags of restraining tissue (superior and inferior oblique muscle tendons) were severed. Hemorrhage, which was likely to be profuse when the nerve was cut, was controlled by pressure applied with a cone-shaped cotton tampon beneath the conjunctiva and directed toward the apex of the orbit. After the hemorrhage had been controlled, which was ordinarily within 10 minutes, the conjunctiva was sutured together with three well-spaced silk sutures. Ophthalmic ointment was applied, the lids were closed, and eyepads were placed and held in position with a firm bandage.

Evisceration was employed only in the presence of panophthalmitis, which was seldom observed in the forward area. The cornea was excised, and the contents of the eye were scooped out with a blunt curette. Care was taken to remove all of the pigmented tissue, so that the walls of the scleral cavity were clean in all areas. If the operation had been performed properly, there was little or no bleeding. Ophthalmic ointment was applied, and the operation was concluded by closing the eyelids and applying eyepads, which were held in position with a firm bandage.

If the eyeball had disintegrated as the result of injury, the tissue of the eyeball was identified and removed, but ocular muscles and conjunctiva were preserved as far as possible.

SPECIAL TYPES OF INJURIES

The injuries most frequently observed as the result of combat were those due to concussion and those due to penetration or perforation by foreign bodies.

Injuries Due to Concussion

The results of concussion varied within a wide range and depended on the degree of the original trauma. Ruptures of the iris and ciliary body were extremely common. Rupture of the sclera occurred independently or in association with dislocation of the lens beneath the conjunctiva. Milder degrees of concussion resulted in intraocular hemorrhages, particularly in the anterior chamber, which sometimes were severe. The formation of Vossius rings was not unusual. If rupture of the choroid was extensive, the eye was usually so filled with blood that detailed inspection of the anterior portions was not immediately possible. When the blood had been absorbed, the typical picture was edema of the overlying retina, with large areas of bright-red blood. Secondary pigmentation followed.

The severity of the initial ophthalmoscopic picture was not an indication of the final visual result. In numerous cases in which the blood was absorbed, good vision returned. It was not unusual, however, to observe the development of secondary atrophy of the nerve fibers, with a serious loss of vision. Daily studies of the field of vision carried on over a long period of time showed great fluctuations in the size and shape of scotomas before the final result was certain. Cases of this sort gave rise to considerable confusion in diagnosis before ophthalmic officers became experienced in battle casualties, since they were likely to be mistaken for detachment of the retina, which, as a matter of fact, was seldom observed, either primarily or during the evolution of the condition.

The most satisfactory form of treatment was complete bed rest, with the eyes occluded for the first week and covered with pinhole goggles thereafter. The duration of the stay in bed depended upon the findings in the individual case.

Concussion frequently resulted in rupture of the lens capsule and the development of traumatic cataract. In some instances, evulsion of the optic nerve occurred. This type of injury was observed not only when a missile struck the eyeball or traversed the orbit but also, as the result of blast, when no foreign body struck or penetrated the eye. Absorption of blood from the vitreous was an exceedingly slow process. Large dehemoglobinized blood clots could be seen in the vitreous for weeks, and it might be months before there was any change in the picture. Then improvement was often sudden and dramatic.

Foreign Bodies

Intraocular foreign bodies, which were frequent, presented the gravest problems which confronted military ophthalmologists. The over-all results must be classed as unsatisfactory, the fundamental reason being that, because of circumstances, some though not all of which were beyond control, patients

with these injuries seldom came under the early professional care of expert ophthalmic surgeons. The poor results could also be attributed to two other considerations. The first was the frequent multiplicity of the foreign bodies, which under combat conditions were likely to be minute. The second was the nature of the objects, which, in addition to shell fragments and similar objects, might consist of bits of wood and clothing, fragments of vehicles, and even seashells from the beaches of Normandy. Most foreign bodies, however, originated in fragmented explosives, particularly land mines. The metal casing enclosing the explosive was low in iron content and high in magnesium, aluminum, and similar alloys. The result was that the objects were either nonmagnetic or only feebly magnetic and, if they could be removed at all, they were removed with difficulty and with additional trauma to the structures of the eye.

The proportion of cases of intraocular foreign bodies appeared to be consistently related to the type of warfare being waged. When the fighting was intense, the incidence of ocular injuries rose sharply and amounted to approximately 5 percent of the total casualties, with foreign bodies, particularly from fragments of German 88-mm. shells, mortar shells, and land mines, causing the major portion of all ocular injuries. During the highly mobile type of warfare following the breakthrough at Saint-Lô, the incidence of ocular injuries fell to less than 1 percent of the total casualties. When, later in 1944, the advance of the United States armies was slower and the fighting again increased in tempo and intensity, as it did before Metz, in the long struggle before the Siegfried Line, and in the Ardennes, the incidence of ocular injuries again rose sharply.

Land mines did the most serious damage to the eyes of United States soldiers of all wartime causative agents. The resulting injuries, which were practically always extensive, were bilateral in perhaps 70 percent of all cases. Multiple wounds were the rule, and there were likely to be serious wounds elsewhere in the body, particularly in the extremities.

The Sweet method of localization of foreign bodies was generally employed in the European theater. Individual hospitals, however, experimented with other methods, and in some instances came to prefer them. The McGrigor-spectacle method was popular, especially in the mobile hospitals, and the Comberg-Pfeiffer contact-lens method was used in several hospitals to the exclusion of other methods and with most gratifying results. Studies carried out by the senior consultant in radiology, at the request of the senior consultant in ophthalmology, revealed, however, that while the Sweet method of localization was more time consuming than any other method and required greater skill and experience on the part of the radiologist, its results could not be surpassed by those of any other method from the standpoint of accuracy.

The technique for the removal of foreign bodies varied with the exigencies of the individual case, though the general policy was to remove the object by the posterior route, preferably through the ora serrata, after preliminary dia-

thermy ignipunctures. The policy of sending patients with ocular injuries from the combat area to a general hospital as rapidly as possible, without definitive eye surgery, was not always strictly enforced, the ophthalmologists of the army areas being most difficult to control in this respect. Instructions to attempt no extraction until accurate roentgenologic localization had been carried out were also unfortunately not strictly enforced in the forward areas. The ophthalmologists in these areas were usually not thoroughly qualified ophthalmic surgeons, their facilities for accurate localization of foreign bodies were decidedly limited, and frequently they failed to realize that precise localization is essential before extraction is attempted. The result was that early in the campaign many casualties with foreign bodies were received in general hospitals after unsuccessful attempts at removal had superimposed trauma, often of considerable degree, on the original injury.[4]

An analysis of case histories shows beyond question that the percentage of successful extractions of intraocular foreign bodies depended almost entirely upon the skill and experience of the surgeon in charge of the case. The average of successful removal for the whole theater was about 50 percent. At least one ophthalmic surgeon, however, had 76 percent of successful cases, while in the hands of inexperienced ophthalmologists successes might fall as low as 1.5 percent.

The most serious of all injuries were those in which the foreign body penetrated the entire eyeball. If the missile was large, the eye promptly disintegrated. If it was small or relatively small, the initial intraocular hemorrhage was practically always serious, and secondary hemorrhages were frequent. Phthisis bulbi was the usual end result, in spite of treatment by complete bed rest, atropinization, chemotherapy, and binocular occlusion until it was thought safe to permit the uninjured eye to remain open.

Foreign bodies in the cornea were frequent. Sometimes the entire cornea might be peppered with small bodies, usually of metal. Treatment in these cases consisted of the removal of the objects readily accessible, the remainder being left in situ. Supportive treatment, with the liberal use of atropine to prevent secondary iritis, gave surprisingly good results, and useful vision was recovered in a large number of cases (fig. 16).

Orbital Wounds

Orbital wounds due to foreign bodies were also frequent. The objects were encountered in all parts of the structure. Often they penetrated the

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[4] Later, Lt. Col. James N. Greear, Jr., MC, who succeeded Colonel Vail as senior consultant in ophthalmology on 29 March 1945, found that many evacuation hospitals were staffed with highly qualified ophthalmologists and that the character of professional work coming from these hospitals reflected the qualifications of the ophthalmologists concerned. It was Colonel Greear's opinion that ophthalmologic patients in general received excellent care during the latter months of the war in Europe.

Had highly qualified ophthalmologists been available and had they been assigned to the various field armies for duty in evacuation hospitals and as part-time consultants to the army surgeons and their surgical consultants, it is safe to assume that closer supervision and control of ophthalmic surgery in the army areas would have been possible.—J. B. C., Jr.



FIGURE 16. A foreign body being removed from the cornea of a soldier in the 3d Station Hospital, Tidworth, Wilts, England.

accessory sinuses, and not infrequently they passed into the brain. The management of uncomplicated cases, in the absence of symptoms and of interference with function, was one of watchful waiting. Probing was forbidden. The results of conservative therapy were generally good.

In more complicated wounds of the orbit, the ophthalmologic officer was instructed to seek consultation with the otolaryngologist and the neurosurgeon. If the floor of the orbit had been fractured and extensive plastic repairs were necessary, the patient was evacuated to the Zone of Interior as promptly as possible. Treatment in the theater was limited to measures to protect and save the eye and to prevent secondary contractions.

Other Injuries

Only a few perforating injuries of the eye occurred as the result of wounds with bayonets or knives. Burns of the eyeball were unusual, but burns of the lids were common. On the whole, the treatment of this type of injury was reasonably good, though protection of the eyeball was not always employed. Tarsorrhaphy was occasionally performed; it could have been used with advantage much more frequently.

An interesting group of injuries, which fortunately were uncommon, were

those in which the eyelids were seriously damaged and the eyeball was left exposed. Whenever possible, the remnants of the eyelids were sutured together to protect the eyeball. If this could not be accomplished, the eyeball was protected by conjunctival flaps or skin flaps. If this also was impossible, the desperate method was adopted of performing tenotomy on all the recti muscles, so that the eyeball could be rotated underneath the conjunctiva.

Remarkably few ocular injuries occurred as the result of shopwork, in spite of the fact that protective goggles were seldom issued and were not usually worn when they were available. Although some men lost their eyes as the result of accidents in tennis, baseball, skeet shooting, and similar sports, constant efforts at prevention kept these costly injuries to a small number.

SPECIAL THERAPEUTIC METHODS

Atropinization.—Although, as has been mentioned, the supply of drugs necessary in ophthalmology was nearly everywhere adequate, atropine was frequently not used so freely or so promptly as it should have been in the early management of eye casualties. This was particularly true in evacuation areas. It was not unusual for a patient obviously in need of atropine to pass through half a dozen installations in the chain of evacuation before receiving it. Serious complications frequently resulted from the omission of this precaution, but the error continued to occur in spite of admonitory circular letters and word-of-mouth instructions and indoctrination by the senior consultant in ophthalmology and by regional consultants.

Conjunctival flaps.—Conjunctival flaps were used in all varieties of penetrating wounds, and many eyes were saved by this simple procedure. It could be carried out not only by the trained ophthalmic surgeon but even, in emergency, by inexperienced ward surgeons.

In two cases in the theater in which part of the damage of perforating injuries consisted of loss of a portion of the cornea, so that a conjunctival flap was impossible, a fascia lata strip was sewed across the defect, and the eye was saved. This ingenious technique was devised by Capt. Eugene W. Anthony, MC, of the 52d General Hospital.

Evisceration and enucleation.—It was the policy to limit evisceration to the cases in which panophthalmitis progressed in spite of treatment. For other cases in which radical surgery was done, enucleation was advised, with the use of a glass implant or an acrylic ball. The plan was not universally carried out, the implant frequently being omitted in evacuation hospitals in forward areas, even when the operation was done by the ophthalmologic-otolaryngologic officer. It was not exceptional, particularly in the early days of the campaign, to observe sockets which were greatly contracted because enucleation had been poorly performed. Occasional contraction of the sockets occurred because a general surgeon had removed the contents of the orbit and packed the cavity with gauze and sulfa crystals.

Preliminary suture of eyelids. An unnecessarily large number of secondary plastic repairs resulted because, in spite of directives and indoctrination directed to that end, preliminary suture of wounds of the eyelids was seldom carried out.

Muscle surgery. Surgery to correct imbalance of the ocular muscles was not approved for the purpose of improving the appearance of the soldier or for obtaining binocular fusion. This was obviously a sensible policy. For one thing, it was not considered reasonable to tie up beds in an overseas theater for patients operated on for purely cosmetic reasons. For another, intolerable diplopia sometimes resulted, rendering the man unfit for military duty. A defect incurred under these circumstances was classified as having been incurred in line of duty and therefore as pensionable. In spite of the logic of this policy and the prohibition against such surgery set forth in official communications, operations for strabismus continued to be performed occasionally, even after D-day.

Anesthesia. Although local anesthesia was frequently used, the most popular anesthetic for ophthalmic surgery throughout the European Theater of Operations was pentothal sodium. Without exception, it proved an almost ideal anesthetic agent for all the usual operations.

COMPLICATIONS

Intraocular infections were exceedingly uncommon, probably because of the liberal use of penicillin after it became available and of the sulfonamide drugs, both of which were used by the routes and in the doses usual in civilian practice. It was remarkable to observe how even panophthalmitis and endophthalmitis could be aborted by the use of penicillin parenterally, supplemented by the injection into the anterior chamber or the vitreous of a solution containing 500 units per cubic centimeter. Sulfathiazole, and later sulfadiazine, in a suitable base, were frequently used locally in the form of 5 percent ointments.

Secondary glaucoma, which was a not infrequent consequence of concussion with intraocular hemorrhage or of secondary hemorrhage, was extremely difficult to treat. Repeated paracenteses were advised, with retrobulbar injection of procaine hydrochloride and of 40 percent alcohol if pain was intractable.

The incidence of sympathetic ophthalmia was remarkably low in the European theater. The general and station hospitals which reported their ophthalmologic statistics for 1944 noted only 10 cases. The absence of this serious complication, while it was in line with the decreasing incidence observed in civilian practice, can probably be attributed to the routine use of the slit lamp, the early diagnosis and appropriate treatment of most injuries, and the vigilance of responsible medical officers.

Injuries of the eye were, fortunately, seldom fatal in themselves. In perhaps 5 percent of all cases, however, they were associated with serious head injuries, in connection with which a large number of fatalities ensued.

CHAPTER VII

Administrative Aspects of Ophthalmology in the Southwest Pacific and Pacific Ocean Areas

Webb P. Chamberlain, M. D.

The practice of ophthalmology in the Southwest Pacific and Pacific Ocean areas in World War II was, like the practice of all medicine and surgery in those areas, conditioned by the enormous areas over which fighting occurred. The differing climatic conditions, the tropical environment, and the great distances between bases created problems of disease and of treatment peculiar to these regions. The poor condition of many patients with ocular injuries when they arrived at fixed hospital installations was often to be explained by the fact that, especially in the early months of the New Guinea campaign, they had been evacuated from 2,000 to 3,000 miles from the point of injury.

MEDICAL INSTALLATIONS

The 4th General Hospital, which was set up at Melbourne, Australia, early in March 1942, was the first medical unit to function as a hospital in the Southwest Pacific area, and its ophthalmology department was the first such department to function there. By the middle of 1942, the 118th General Hospital in Sydney and the 105th and 42d General Hospitals in Brisbane were also in operation, and, because they were particularly well staffed, their ophthalmology departments were serving informally as centers for the diagnosis and treatment of eye diseases and injuries. They cared for casualties evacuated from the islands and for patients received from station hospitals supporting troops staging in Australia. Good work was done in field, evacuation, and station hospitals, but in many instances trained ophthalmologists were not attached to the smaller units, and a relatively high proportion of eye casualties had to be transferred to general hospitals.

After August 1943, during the New Guinea campaign, the 42d General Hospital in Brisbane cared for a large proportion of the ophthalmologic battle casualties, who had to be evacuated by air for a distance of 1,500 miles. It was not until 1944 that well-staffed general hospitals were established in the New Guinea bases. When these units were set up, excellent service was afforded these casualties without the previous necessity of an extremely long line of evacuation.

Eye centers of the type established in other theaters of operations and in the Zone of Interior were never established in the Pacific theaters. Patients were transferred from smaller hospitals to larger hospitals, not by plan but simply because, as already noted, there were neither facilities nor personnel to care for them in the smaller units. On the other hand, when preparations were made for the invasion of Japan, the 26th Medical Center was established in Manila, and it was planned that the several general hospitals which composed it would furnish specialized eye care. Had the war continued, it is possible that, by a process of evolution, something approaching the type of eye center established elsewhere might have developed in this medical center.

PERSONNEL

No consultant in ophthalmology was ever appointed in the Pacific. The number of medical officers certified by the American Board of Ophthalmology was small, and their distribution was not always well planned. When a competent ophthalmologist was placed in a dispensary unit, for instance, as was sometimes done, his abilities were not utilized to the maximum.

The organization of the ophthalmologic and otolaryngologic sections of hospitals as a single service gave rise to the difficulties which might have been expected in an era in which only the occasional physician was adequately trained in both specialties. Ophthalmology, which is a highly specialized field, was handled in many installations by physicians whose training and certification were in otolaryngology, while ophthalmologists of all degrees of training and experience dissipated their energies in otolaryngologic work for which they had had no training. In addition, the ophthalmologic experience and training of these men were lost in many instances, because of the fact that promotion beyond the rank of major was possible only by their assumption of duties not related to the specialty. Well-qualified ophthalmologists were thus lost to clinical ophthalmology because they naturally took the only available means of gaining additional rank and the associated increases in pay and allowances.

Trained ophthalmologic nurses were not available, but many nurses were given on-the-job training in the exacting requirements of the specialty. They rendered valuable service, although it was difficult to keep them from being rotated after they had been trained.

Properly trained enlisted personnel proved a great asset in the practice of ophthalmology in the Pacific. In many instances, these men, after training, replaced nurses in the outpatient dispensaries. Men who had been optometrists in civilian life often served as refractionists, but many of the best refractionists in the Pacific received all their training in the Army. Occasionally, patients who came to the hospital only for refraction were never seen by a medical officer. This occurred only in hospitals where an otolaryngologist was also in charge of ophthalmology, but it was not considered acceptable procedure, no matter what the reason for it.

During the last 18 months of the war, the maintenance of morale had become a problem to those ophthalmologists, as probably to other segments of the Army, who had spent 3 years in an alien environment and climate and who had felt the lack of suitable furlough areas in the Pacific theaters and the lag of redeployment. Rotation of personnel, with at least short periods of duty at eye centers in the United States, would have been advantageous for ophthalmologists who were almost completely removed from the advances being accomplished in their specialty and who, because there was no consultant in ophthalmology to see to it that they were kept informed, were able to learn little about what was going on in the Zone of Interior and in other theaters. A proper distribution of textbooks and current periodicals would have been of great assistance in this respect, but it was not accomplished.

FACILITIES

Utilization of Space

Ophthalmologic facilities in the Pacific varied with the type of construction of the hospital in which they were housed. Eye clinics, wards, and operating rooms were ample in space and of the most modern type in such installations as the Royal Melbourne Hospital, which was approaching completion when it was taken over by the United States Army. Other units were often of the cantonment type, sometimes supplemented with tent units, with the prefabricated structures modified, as necessary, to afford better ventilation and insulation from heat. In forward areas, hospitals were housed in tents or other structures in which extensive improvisation was necessary to establish a practical setup for ophthalmic surgery.

Frequent revisions of the space allotted to the management of eye casualties were necessary because the originally allotted space was inadequate. This was chiefly because planning was based on the mistaken assumption that a single officer would be adequately trained to handle both ophthalmology and otolaryngology.

Equipment and Supply

During the first months of the war in the Pacific, there was a notable lack of equipment for the diagnosis and treatment of ophthalmologic conditions, and much of what was supplied was of poor quality and otherwise unsatisfactory. The slit lamp and the corneal microscope are indispensable in the diagnosis of ophthalmic conditions, but it was not until 15 months after the arrival of the first hospitals in the Pacific that these items began to be received from the Zone of Interior. Giant magnets were in insufficient supply. Tonometers were not reliable. Prosthetic spheres for implantation after enucleation were often unobtainable. Facilities for the surgical repair of retinal detachment were lacking. The National ophthalmoscope supplied was regarded as unsatis-

factory, because it was impossible to obtain a clear focus with it and because of the presence of a confusing light reflex in the center of the field to be examined.

By the middle of 1945, many of these difficulties had been remedied. The ophthalmologic department of the 118th General Hospital, which was set up in Sydney in 1942, had been able to procure a slit lamp in Australia as well as other equipment, and other general hospitals, through the initiative of individual ophthalmologists, had also been able to supplement their inadequate equipment from civilian sources or through facilities and cooperation of the Medical Department of the Australian Army.

A survey [1] of ophthalmologic service in the Pacific, covering 14 general hospitals, 1 field hospital, and 2 evacuation hospitals, was reported to the Theater Surgeon, Army Forces, Pacific, 17 July 1945, and produced the following data:

1. At this time, the two evacuation hospitals and the single field hospital investigated were well equipped.

2. Of the 14 general hospitals investigated, 13 did not possess tangent screens, 10 lacked slit lamps, and 10 lacked perimeters.

3. Small Lancaster hand magnets were in plentiful supply and were well distributed. Shortly before the survey, five giant magnets had been received in the theater, three of which had been delivered to general hospitals. It was thought that flexible use of the two remaining giant magnets would solve this particular problem for the theater.

Instruments. In the early months of the war in the Pacific, the instruments supplied for ophthalmic surgery were in short supply and were frequently of poor quality and antiquated design. They were also far too coarse for delicate eye surgery. The supplementary emergency eye kits, which were issued indiscriminately to general hospitals and advanced field units, did not serve the differing needs of those installations. The large case provided for eye injuries, item 93290 in the supply catalog, was more satisfactory. Units which arrived in the Pacific after 1944 were usually provided with it, but units in the theater early in the war did not receive it until later. This item was requisitioned repeatedly by the 118th General Hospital, for instance, beginning early in 1943, but it was not received until March 1945.

The instruments in the large case could have been improved upon in both selection and number. A Schiötz tonometer, toothed and intracapsular capsule forceps, and a corneoscleral trephine were missing. Sharp instruments were not held in racks, with resultant damage to their cutting edges. It would have been desirable, moreover, to have racks which could have been removed in sections and used to hold the instruments in sterilizing solutions.

There were no facilities in the Pacific for the repair and servicing of ophthalmologic instruments. The lack was inconvenient and uneconomic and also made the instruments less effective than they might have been, since

[1] Lt. Col. Britain F. Payne, MC, Report to Theater Surgeon, Army Forces, Pacific, 17 July 1945, subject: Ophthalmic Service in Army Installations in the Southwest Pacific and Western Pacific Areas.

certain ophthalmologic instruments, such as cataract knives and keratomes, are often better when they have been resharpened than when they are new.

The care and preservation of ophthalmologic instruments was a major problem in the Pacific. All metal rapidly developed rust and corrosion in the humid tropical climate, and the mere coating of instruments with oil did not prevent their deterioration. Sharp instruments, such as cataract knives and keratomes, deteriorated with special rapidity. The case for eye injuries (item 93290) which was supplied later in the war included a dehydrating agent but was not convenient for the storage of instruments in daily use. The development of a convenient storage cabinet dried by an electric-light bulb would have assisted in the solution of this problem, which remained a serious one throughout the war.

Drugs

The sulfa drugs and penicillin, after the latter was introduced, were usually in ample supply and were used to great advantage. Most ophthalmologic drugs were also in full supply, although atropine and Pontocaine Hydrochloride were occasionally scarce items. Pilocarpine, to counteract cycloplegia, was also frequently unavailable, as was eserine. Because of its effect on the corneal epithelium, many ophthalmologists objected to the use of cocaine as a local anesthetic agent and would have preferred Pontocaine, Metycaine, or Holocaine. Butyn and Metaphen ointments were available but for many reasons were regarded as undesirable.

Optical Supply

Early in the war, United States Army units in Australia were supplied with glasses by Australian opticians working under contract to the United States Army. The quality of material and the character of the service were good. Later, the United States Army set up its own optical units at various bases, and these units, for the most part, supplied satisfactory service.

Replacement of broken lenses for combat troops on the beaches was originally a serious problem. Many men who wore glasses had to be removed from their posts because they could not continue their missions after their glasses were broken. Frequently, these men had to be evacuated and sent to hospitals far in the rear for refraction and prescription for new lenses, and delays ranging from a few weeks to as long as 3 months occurred before the glasses were supplied and the men were returned to their units. Later, the attachment to each corps of small optical units which went forward with landing troops on each D-day permitted broken glasses to be replaced on the spot and kept men available for action when they were most needed.

Lack of uniformity and of clarity in the regulations covering certificate requirements on the breakage and loss of glasses gave rise to a good deal of confusion and delay. This was particularly true of the requirement that the

certificate of loss or breakage in line of duty be signed by a responsible officer. Unless an officer actually witnessed the destruction or loss of the glasses, he was in no position to certify that the loss was in line of duty. On the other hand, if a man deliberately lost or broke his glasses, in the hope of escaping arduous or dangerous duty, it was almost impossible to prove that the act was intentional.

In the early months of the war, broken glasses often had to be shipped a distance of a thousand or more miles for repair. They were seldom accompanied by proper certificates and, if they were returned for completion of the necessary paper work, many additional weeks of lost time were added to the time loss inevitable in the length of the supply line. On the other hand, according to regulations, only an officer in the soldier's unit was authorized to sign the certificates. The optical-supply unit was therefore left on the horns of a dilemma, which was solved in various ways.

In the early days of the war in the Pacific, many refractions had to be done and many glasses had to be supplied for men who were sent overseas before their eyes had been properly refracted and appropriate glasses had been supplied. One infantry sergeant, for instance, who was seen at this time, had been sent overseas with a combat unit without a duplicate pair of glasses, although he had 9.00 diopters myopia and uncorrected vision of 2/200 in each eye.

Many soldiers with refractive errors which did not qualify them to receive Government-issue spectacles had symptoms which could probably have been relieved by the proper glasses. No facilities were available for dispensing bifocal lenses, and many persons had to be given two pairs of spectacles when bifocal glasses would have been more advantageous. The lack of facilities for bifocal lenses furnished a particular problem in installations which cared for Philippine Army personnel, among whom presbyopia was common.

In 1945, two general hospitals, the 60th and the 118th, were designated for the manufacture and fitting of plastic eyes. The end of the war came, however, before the program could be put in operation.

CHAPTER VIII

Clinical Policies in Ophthalmology in the Southwest Pacific and Pacific Ocean Areas

Webb P. Chamberlain, M. D.

COMBAT-INCURRED INJURIES OF THE EYE[1]

General Considerations

The lack of a consultant in ophthalmology in the Pacific explains why no general policies were formally issued for the management of ophthalmic injuries and diseases. As a result, these conditions were managed, for the most part, on the basis of the individual officer's practices in civilian life.

Clinical policies in ophthalmology, furthermore, as has already been noted (p. 133), were necessarily predicated on the length of the evacuation lines which, in the Pacific, were long in the first months of the war and were frequently long even toward the end of hostilities. The time to save an injured eye is immediately after it is injured, but a competent ophthalmic surgeon must be available to secure optimum results. Because of the shortage of trained ophthalmologists, however, and because of the relative infrequency of injuries of the eye, specialized personnel were not usually available in forward areas. If the condition was one of great urgency, general surgeons handled it as best they could. If it was not, by far the best solution of the problem was to do as little as possible, preferably nothing except to apply a simple dressing, and to evacuate the casualty as promptly as possible to a hospital in which an experienced ophthalmic surgeon was available.

Failure to observe these general principles of management was sometimes responsible for distressingly poor results in ophthalmic surgery. Eyes were sometimes enucleated too hastily. Glass-ball implants were not always used, even after they became generally available, and often several plastic operations were necessary before prostheses could be worn satisfactorily. Lacerations of the eyelids were also frequently treated unwisely, with generous debridement and open-wound healing, though these practices were in direct violation of instructions from the Office of the Surgeon General.[2] Numerous deformities

[1] A statistical presentation of injuries of the eye in the United States Army during World War II is contained in appendix A, p. 556.

[2] War Department Technical Bulletin (TB MED) 147, March 1945, subject: Notes on Care of Battle Casualties.

resulted, and plastic surgery, with long periods of hospitalization, was necessary to correct them.

Special Types of Injury

A special problem in the Pacific, resulting from the type of fighting very often necessary, was the relatively large number of injuries caused by small-arms fire. Damage to the eyes in this type of injury was often associated with extensive damage to the face, lids, adjacent sinuses, and cranial contents. The immediate need in forward installations was to combat shock and infection. When the casualties were received in rear installations, the wounds were almost always infected, and immediate plastic repair was impossible. Except for the removal of shattered globes, treatment had to be limited to clearing the infection and minimizing the deformities.

Ocular injuries in the Southwest Pacific Ocean area included an unusually large number of nonmagnetic intraocular foreign bodies. These objects consisted, as in other theaters, of nonmagnetic metals and alloys used in modern munitions and, in many cases, they also included multiple fragments of the coral rock which is present on all Pacific islands. It was the policy to evacuate patients with this type of injury to the Zone of Interior by plane, as rapidly as possible and with high priority. For military and other reasons, this policy, unfortunately, could not always be put into effect, and air evacuation was often irregular and slow.

DISEASES OF THE EYE

General Considerations

Constant exposure to the heat, dust, and glare of the tropics resulted in a relatively high incidence of all types of external diseases of the eye.[3] Blepharitis, conjunctivitis, various forms of keratitis, iridocyclitis, choroiditis, retinitis, and optic neuritis were unusually frequent and were often resistant to therapy and prone to recur. Patients with malaria were particularly likely to develop herpes simplex keratitis.

Hospitalization for even simple diseases was necessary for much longer periods of time than in civilian practice, and trivial inflammations were likely to become incapacitating. One patient, for instance, was hospitalized 8 times over a 9-month period for recurrent acute keratoconjunctivitis, which was apparently aggravated by duty under tropical conditions. The infection was controlled slowly during the periods of hospitalization but recurred promptly when the soldier returned to his unit. During this 9-month period, he was able to perform full duty for less than 4 weeks. Eventually, he was evacuated for nontropical duty. It was found, in numerous similar instances, that the

[3] A statistical presentation of diseases of the eye in the United States Army during World War II is contained in appendix A, pp. 549-555.

best plan was to evacuate patients to the Zone of Interior as soon as it became evident that their ocular disease was aggravated by service in the tropics and was likely to incapacitate them repeatedly.

Trachoma was not a disease of any consequence in the Pacific, though patients with old scarring of the cornea were likely to develop severe irritations and recurrent inflammation which eventually necessitated evacuation. Anophthalmic troops, who were sent overseas in 1942–44, chiefly with port battalion units, proved of little use. Under tropical conditions, the majority developed irritation in the socket, usually associated with a severe purulent conjunctivitis which responded poorly to treatment.

The management of toxic amblyopia was not a frequent problem, since the primary disease was almost invariably fatal.

Correction of defects which had existed prior to induction was carried out in a number of cases in which operation did not seem necessary. This was particularly true of strabismus, the surgical correction of which was later forbidden.

Two unusual conditions were observed in the Pacific: Ocular complications associated with scrub typhus, and bilateral corneal edema precipitated by Atabrine.

Ocular Complications of Scrub Typhus

Extraocular and intraocular changes.—Weekly examinations of the eyes of 451 patients with scrub typhus fever over a period of 18 months in the Southwest Pacific theater revealed extraocular and intraocular changes in a large number.[4] The weekly examinations included opthalmoscopy under mydriasis; tests for visual acuity; determination of the visual fields, with plotting of the fields of most of those showing intraocular changes; and slit-lamp examinations after the patients had become ambulatory. Peripheral-field determinations were done on a 330-mm. radius perimeter with a 1-mm. white test object. Central fields were plotted with the same object on a tangent screen at 1 meter.

The most common extraocular change was conjunctival hyperemia, which occurred during the early stages of the disease in 38.8 percent of the 451 patients. Discharge was usually scanty, and the injection disappeared during the second or third week of illness. Subconjunctival hemorrhages appeared in the first 10 days of illness in 6.4 percent of the patients. The hemorrhages, which were usually bilateral, were massive, often covering a third to a half of the exposed sclera. Eschars of the eyelids appeared in 4.4 percent of the patients and ecchymoses in 0.8 percent. In two patients, an eschar typical of the primary lesion of the disease which follows a mite bite involved the upper lid.

Keratitis developed in 4.4 percent of the patients, and the same proportion developed nystagmus. In two instances, the nystagmus was of the coarse,

[4] Schele, H. G.: Ocular Changes in Scrub Typhus. A Study of 451 Patients. Army M. Bull. 5: 423–427, April 1946.

irregular, jerky, incoordinate type. It occurred only when fixation on an object was attempted and closely resembled the type of incoordination seen in the extremities in association with cerebellar lesions.

The intraocular changes were even more noteworthy than the extraocular in patients with scrub typhus fever. Venous engorgement, which occurred in 67.2 percent, was the most consistent change in the fundus. It had its onset during the first or second week of illness and always preceded any other intraocular change. It frequently progressed until the veins were from 2 to 2½ times the diameter of the arteries. Other venous changes were associated with engorgement. The veins became irregular in caliber, this phenomenon accentuated by the increased tortuosity of the vessels. Because of localized dilatation, they often appeared sausagelike near the disk. Although thrombosis frequently seemed imminent, it occurred only once in the entire series. The outline of the veins was often blurred, possibly as the result of exudation through their walls. Blurring was not the result of the presence of a true perivascular sheath, for the veins had a diffuse, veiled appearance, which was perhaps partially caused by retinal edema, although the arteries never showed a comparable degree of involvement. The veiling was more marked at the arteriovenous crossing, at which point the veins often had an interrupted appearance.

Edema of the disk and retina was observed in 36.1 percent of the 451 patients with scrub typhus. Both structures were always involved, and the involvement was always bilateral. The edema was preceded by marked engorgement of the retinal vein in all patients and was usually preceded by one or another of the venous changes already described. Edema was usually of comparable degree in the disk and the retina, though in some instances, the swelling of the disk suggested papilledema. The changes in the fundus, however, were not the result of increased intracranial pressure. In other instances, the retina showed marked edema while the disk showed almost none. Edema of the disk and retina appeared during the second and third week of illness, reached its maximum intensity during the next week or two, and then subsided slowly, the eye grounds returning to normal about the seventh or eighth week of illness.

Retinal hemorrhages, usually superficial, were observed in 6.6 percent of the patients. Fluffy white exudates occurred in 4.9 percent. These exudates were usually of the cotton-wool variety, though they sometimes resembled ganglioform degenerative lesions. Both hemorrhages and exudates were most likely to occur in patients who presented edema of the disk and retina.

Dustlike opacities of the vitreous, which were most numerous in the posterior vitreous, were seen in 4.6 percent of the patients; in these cases, there was no further evidence of uveitis. Definite uveitis appeared in 1.3 percent. It was usually indolent, with only slight photophobia and usually with no ciliary injection. Nearly all the patients in this group also presented edema of the disk and retina, as well as the venous changes described.

Patients with uveitis occasionally complained of blurred vision, though visual acuity was undisturbed and no changes in the visual fields were demonstrable. Visual function was not altered in the remainder of the patients.

The retinopathy fairly typical of mite typhus thus consisted of bilateral edema of the disk and retina; hemorrhages, usually superficial; and white exudates, with a bilateral uveitis superimposed in a small proportion of cases. Since venous changes confined to the retina are extremely difficult to evaluate, a diagnosis of retinopathy was not made unless other changes were also present. Such pathologic studies as were possible suggested that the primary lesion in the eye consists of an inflammation of the highly vascular uveal tract. This is what might be expected, for vasculitis and perivasculitis of the smaller blood vessels are characteristic pathologic manifestations of scrub typhus. The significant clinical incidence of vitreous opacities and of bilateral uveitis supported the pathologic evidence. Even though the retinal picture predominated in these cases, it was believed that the choroidal disturbance was probably the underlying process.

Diagnostic considerations.—The ocular changes in certain of these cases proved useful in the diagnosis of scrub typhus. The diagnosis of this disease in a febrile patient rests on the presence of the mite-bite ulcer, the rash, and the generalized lymphadenopathy. Confirmation is provided by the *Proteus* OXK titer. In a number of the patients in this series who failed to show one or more of the essential criteria for early diagnosis, the diagnosis could be made on the development of eye ground changes, because the retinopathy of scrub typhus in this geographic area was found to be practically pathognomonic. Similar changes were not found in other acute febrile diseases. Since the retinopathy developed on an average of 3 to 4 days before the OXK agglutination reaction became positive, it afforded diagnostic help before laboratory evidence was available. In several patients with undiagnosed fevers, the ophthalmologic findings first suggested the diagnosis of scrub typhus. In several other cases, in which scrub typhus was suspected but was not proved until considerably later, the retinal findings helped to confirm the diagnosis.

Patients with severe disease were more likely to present retinopathy than those with moderate disease, and those who developed complications (damage to parenchymal organs) also showed a higher percentage of retinopathy than patients without such complications.

The relationship between intraocular changes and the stage of recovery was particularly important. As a rule, full recovery can be fairly well estimated on the basis of the patient's general condition. In a patient with retinopathy, however, the time of disappearance of the retinal lesion furnished an additional objective criterion. It seemed reasonable to assume that the disappearance of the retinal changes paralleled the disappearance of damage to tissues elsewhere in the body.

Since eye ground changes were almost the last physical signs to disappear

in the cases in which they were present, no patient was returned to duty until his retinopathy had disappeared.

Corneal Edema Resulting From Atabrine Therapy

Symptoms and signs.— Over an 18-month period in the Southwest Pacific, a number of patients were observed with bilateral haziness of the cornea of obscure origin. During the 8-month period ending in March 1945, four patients with this condition were studied in detail at a single hospital.

Impaired vision was the only presenting complaint in all four cases. The blurring was present at all distances. There was no apparent restriction of the visual fields. The condition was most troublesome at night, when there was a pronounced dispersal of lights. Ocular irritation, pain, redness, and conjunctival discharge were associated with the condition. In no instance was there a history of injury to the eyes or of undue exposure to brilliant light, dust, or irritants. The diet, which consisted largely of canned foods, had apparently been adequate. Moreover, within the previous 2 months, all 4 patients had either been stationed in the United States or had been on extended leave in New Zealand and had consumed ample quantities of fresh fruit and vegetables, meat, and dairy products.

Visual acuity was impaired to about the same degree in both eyes in all cases. The first examination revealed a diffuse haziness of the cornea, which had a granular appearance as the result of innumerable minute punctate opacities evenly dispersed over the surface. Examination with the slit lamp and the corneal microscope showed these delicate opacities to be located near the level of Bowman's membrane. There seemed to be increased reluceney of the most superficial layers of the corneal parenchyma, as well as involvement of the deeper epithelial cells. At the time of the examination, the epithelial surface was smooth and did not stain with fluorescein. Ophthalmoscopic study with a +8.00-diopter lens revealed the opacities as a fine granular stippling seen in silhouette against the fundus reflex.

The conjunctiva was not injected, and there was no evidence of inflammation involving the aqueous, iris, lens, vitreous, or fundus. The visual field was normal in all respects. Repeated tonometric readings of intraocular tension taken at various hours of the day were within normal limits.

In each case, the general history and the physical examination on admission disclosed no evidence of systemic disease. Possible dental, otolaryngologic, and urologic foci of infection were ruled out by appropriate consultations. Initial laboratory tests, including complete blood counts and urinalysis, blood serology (Kahn), and smears for malaria revealed nothing abnormal. Cutaneous reactions were negative for tuberculosis (purified protein derivative) in both dilutions. Patch tests with powdered Atabrine gave a negative reaction.

Therapy.— During the first weeks of hospitalization, there seemed some improvement without specific treatment. Two of the patients were treated

with atropine and hot compresses, and all received large doses of polyvitamin preparations and riboflavin without apparent benefit. The residual edema and slight blurring fluctuated in intensity but never completely disappeared. The condition of three patients, however, seemed so much improved that the minimal blurring and dispersals of lights at night did not appear sufficient to warrant further hospitalization, and they were discharged. In each instance, pronounced edema and blurring recurred, and rehospitalization was necessary. The fourth patient developed severe hepatitis with clinical icterus and ascites, and continuous hospitalization was required until his death.

Special studies with Atabrine. At the time of their first hospitalization, all four patients had been receiving Atabrine. Three had been taking the drug from 4 to 6 weeks before the initial visual disturbance. The fourth had been taking it for 20 months, but, 7 weeks before he first noticed blurring of vision, the usual daily protective dose of 0.1 gm. had been increased to 0.2 gm.

When no cause for corneal edema could be found, even though the reactions in the patch tests for Atabrine had been negative, possible toxicity from this cause was investigated by first discontinuing the drug entirely for a month and then by administering it in larger doses. These studies were carried out on three patients.

During the period in which no Atabrine was taken, there was a slow but definite improvement in the corneal edema and further clearing of the slight visual impairment, though a small amount of edema persisted and there was continued visual disturbance, particularly noticeable in the dispersal of lights at night.

The patients were then given intensive courses of Atabrine therapy, consisting of the administration of 1.2 gm. the first day, 0.8 gm. the second, and 0.4 gm. on each of 4 succeeding days. Patient 3 could not continue the drug beyond the fourth day, because of persistent vomiting, and how much he retained could not be determined. Patients 1 and 2, who completed the full course, each developed pronounced corneal edema beginning approximately 7 days after therapy was begun. Patient 3, who did not complete the course, presented the same manifestation 11 days after the initial large dose. The corneal edema, in all of these patients, was more intense than it had been previously, and, for the first time, there were punctate erosions of the surface epithelium. Atabrine therapy was the only factor in their routine which was altered during this period.

When Atabrine therapy was permanently discontinued, corneal edema subsided gradually. At the end of 1 month, vision, which had fallen to 10/200 in each eye in one case, was approximately 20/20 in all cases. After 8 weeks, there were no demonstrable opacities in two cases, and in the third case only an occasional punctate opacity could be observed.

Studies of hepatic function.— In all four cases of corneal edema, some degree of hepatic dysfunction developed from 3 to 6 months after the initial

visual disturbance. In two cases, icterus was subclinical, and impaired hepatic function was demonstrated only by the hippuric acid excretion test. Severe hepatitis developed in the other two cases, terminating fatally in one case, in which the icteric index rose to a maximum of 170, the serum albumin-globulin ratio was reversed, the sedimentation rate was elevated, secondary anemia was pronounced, and post mortem examination disclosed extensive diffuse necrosis of the liver. This patient had had no Atabrine for approximately 2 months before death. Vision was 20/30 in each eye when the drug was discontinued but, within the next 5 weeks, it became approximately 20/20 in each eye. Residual corneal edema persisted, but repeated examinations with the ophthalmoscope and hand slit lamp during the terminal phase of illness failed to disclose any demonstrable corneal opacities.

From personal communications with other ophthalmologists, it was estimated that at least 25 cases of this type of corneal edema were seen in the Pacific. The intensive study of these four cases suggests that investigation of hepatic function is indicated in patients with corneal edema apparently precipitated by Atabrine, though liver-function tests are likely to be negative in the initial stages of the edema. When the protective dosage is employed, a period of several weeks may intervene between the first dose of the drug and the initial visual disturbance. When larger doses are employed, the timelag may be reduced to a few days.

During the period these patients were under observation, there was a relatively high incidence of infectious hepatitis in the Southwest Pacific theater. A considerable number of patients hospitalized primarily for hepatic disease were therefore available for examination, but in no instance was corneal edema found.

CHAPTER IX

The Rehabilitation of Blinded Casualties

James N. Greear, Jr., M. D.

HISTORICAL NOTE [1]

Initial Planning

In April 1917, shortly after the entrance of the United States into World War I, the National Defense Council appointed a Subcommittee of Ophthalmology, many members of which subsequently became attached to the Surgeon General's Office in various capacities (p. 1). It was the conclusion of this subcommittee that a program for rehabilitation of blinded casualties could best be undertaken by some agency such as the American Red Cross, which was not connected with the War Department. On the initiative of Dr. James Bordley of Baltimore, a member of the subcommittee, a plan embodying this conclusion was submitted to the American Red Cross, which in turn laid the subject before The Surgeon General, together with an offer to finance the project. The offer was declined, on the ground that it was not the policy of the War Department to accept financial aid from civilian agencies. The program for the care and rehabilitation of the blinded thus became the responsibility of the Surgeon General's Office.

General Policies

Meantime, in the Surgeon General's Office, the Division of Special Hospitals and Physical Reconstruction set up plans for the management of blinded soldiers. The essentials of these plans, which were approved by a committee of prominent educators, were as follows:

1. A special hospital center would be established in France, to which all blinded soldiers would be sent. At this center, an executive officer would be responsible for the direction of the professional and teaching staff. Occupation and recreation for all patients would be inaugurated as promptly as possible after their arrival at the center and would be continued until the time of their debarkation in the United States. Blinded men would be distrib-

[1] (1) The Medical Department of the United States Army in the World War. Washington: Government Printing Office, 1924, vol. XIII, pt. 1, pp. 175–180. (2) Woods, A. C.: The Story of the Red Cross Institute for the Blind (1918–1925) in Relation to the Present Problem of the War Blinded. Am. J. Ophth. 26: 1011–1024, October 1943.

uted among other patients to avoid the depression of segregation in special wards for the blinded, to broaden their interests, and to provide them with assistance from their comrades.

2. In the United States, one or more military stations for the blinded would be established not far from the eastern seaboard. Each of these centers would accommodate a maximum of 200 soldiers, with due regard for their proper classification.

3. A director at each of these installations would be directly responsible for all activities connected with the rehabilitation of the blinded, including the selection of personnel; the determination of the character and extent of training to be provided for each casualty; the recommendation of, and provision for, any additional educational training considered advisable for the special casualty and accepted by him, such as collegiate or professional work or intensive training in shops or factories; instruction in basic skills, such as typewriting; and the approved uniform embossed system in reading and writing; and training in such occupations as dictaphone transcription and switchboard operation and such manual occupations as weaving, woodworking, cement work and netting.

4. A placement and followup program would be set up in each installation. A Federal placement agent would be appointed, whose duty it would be to ascertain opportunities for the blind and to work in cooperation with other Government agencies empowered to make similar surveys for handicapped men. This agent would assist the blinded casualty to obtain employment, always making the effort to return him to his former occupation or to an occupation closely allied to it. It was recommended that civil-service regulations be so amended as to open opportunities for the blind in Government service.

5. Followup observation was to be continued under the Medical Department of the Army during this period of training, in cooperation with the War Risk Insurance Bureau and the American Red Cross.

The original plans for the rehabilitation of the blinded were changed several times. As they were eventually worked out, patients returning from overseas were first sent to General Hospital No. 11 at Cape May, N. J., where special equipment and trained personnel had been provided. When they were no longer in need of hospital care, they were transferred to General Hospital No. 7, better known as the Evergreen School, at Roland Park, Md., where they continued under the care of the Medical Department of the Army until this hospital was turned over to the Red Cross in May 1919.

The Evergreen School

In the summer of 1917, on the suggestion of Dr. Bordley, an estate in the suburbs of Baltimore (Roland Park) was offered to the War Department by the owner, Mrs. T. Harrison Garrett, at a rental of a dollar a year, as a

site for a school for blinded soldiers. After it had been duly inspected by the proper authorities, including a subcommittee of educational workers with the blind, the estate was formally offered to The Surgeon General. The proposal was endorsed by him and later by the Secretary of War. Because of various delays, reconversion of the estate to its new purposes was not begun until April 1918. The first patients, who were received at this time, were housed in such buildings as were available. Educational work was begun in July 1918, but it was not until October of that year that all the construction work was completed, the equipment installed, and a full educational program instituted.

Soon after General Hospital No. 7 began to operate, it became apparent that a more efficient educational service could be conducted for the blinded if they could be discharged from military service, even though military supervision of the men at this hospital was largely limited to the maintenance of order and discipline and the preservation of Government property. The Surgeon General therefore, early in 1919, recommended to the War Department that blinded soldiers who required no additional medical treatment should be discharged from the Army, while those who required further treatment should be transferred to General Hospital No. 2, at Fort McHenry, Md.

Meantime, the American Red Cross had renewed its offer to undertake the rehabilitation of blinded casualties. This time, on the recommendation of The Surgeon General, the offer was accepted, and, on 25 May 1919, all buildings and equipment of General Hospital No. 7 were turned over to the Red Cross, on a revocable lease, and the institution became known as the Red Cross Institute for the Blind. Its director was Lt. Col. James Bordley, MC, who was then assigned to the Rehabilitation Section of the Surgeon General's Office. Such medical care as the students at the school required was supplied by consulting ophthalmologists and by special consultants employed as necessary by the Public Health Service.

The Evergreen School was operated under Red Cross management until 1 January 1922, when it was taken over by the Veterans' Administration, which continued to operate it until it was closed in June 1925. The last period of its operation, according to Dr. Alan C. Woods, who was continuously associated with the school from March 1920 until its closing, was a period of "gradually waning and diminishing usefulness and activity."

Census. The number of students at General Hospital No. 7 while it was operated under the direction of the Army Medical Department did not exceed 50 at any one time. Under the Red Cross, the student population varied between 100 and 150, 150 being the maximum number who could be accommodated.

Exactly how many men were trained at the Evergreen School during its period of operation is not known. According to Woods, the number was probably in the neighborhood of 400. A number of soldiers blinded by enemy action, accident, or disease did not pass through any school, and a number of

others were trained at other institutions. Woods' estimate is that the total number of men who received special training after World War I because of visual defects must have been in the neighborhood of 500, about 250 of whom were battle casualties.

Classification of cases. Woods, on the basis of his almost 6 years of experience at the Evergreen School, classified the etiologic factors in 325 of the cases observed during that period as follows:

Trauma was responsible for 106 cases, in 78 of which the injuries were the result of enemy action. Of these 78 soldiers, 16 had been blinded in both eyes. In 25 cases, the injury was unilateral, but the sight of the second eye was lost because of such conditions as phthisis bulbi, traumatic cataract, and detachment of the retina. In 10 instances, bilateral concussive changes in the fundus, with final choroidal scars and atrophic choroiditis, were the result of explosions or of remote injuries. In four instances, cortical blindness was the result of occipital lobe injuries.

Disease of the optic nerve was responsible for blindness in 66 instances. Included in this group were 22 cases of primary syphilitic atrophy and 6 cases of toxic amblyopia from poisoning by wood alcohol. Woods attributed the undetermined etiology of 17 instances of primary optic atrophy to inadequate study.

Amblyopia was responsible for 45 cases. In 12 instances, it was attributed to systemic disease. Twenty-seven cases of bilateral amblyopia were of the hysterical variety; three patients in this group were suspected of malingering. The majority of patients whose amblyopia was of hysterical origin were still in the Evergreen School when it was closed. They were then transferred to various psychopathic hospitals, where, in Woods' opinion, they should have been from the beginning. In the six remaining cases, the amblyopia, which was unilateral, was associated with loss of vision in the other eye, or total loss of the eye, from mustard-gas injury, wounds, explosions, and, in one instance, an extensive choroiditis. The hysteria in these cases, according to Woods, manifested itself in the men's "own original disability blindness."

Keratitis was responsible for 17 cases, in 8 of which the disease was of syphilitic origin. Atrophic choroiditis was also responsible for 17 cases.

Retinitis pigmentosa was responsible for 14 cases. The average age of the men in this group was 28 years, and Woods raised the question whether the physical stress of military service might have been a predisposing factor in the early occurrence of this disease in individuals with a hereditary tendency to develop it.

High refractive error was present in 14 cases, in 3 instances associated with choroidal changes. Many of the men in this group were chronic trouble-makers, who had attempted various types of vocational training without success and who had finally been sent to the Evergreen School in sheer desperation.

Cataracts were responsible for 12 cases. Five patients in this group had vision of 20/100 in the better eye and presented no pathologic changes in the affected eye other than posterior cortical cataracts. They preferred, however, to draw pensions rather than undergo surgery.

Injury by gas was responsible for blindness in 10 cases, uveitis in 8 cases, and trachoma in 5 cases. Two of the five patients with trachoma had apparently been inducted with the disease. All had marked corneal involvement and were industrially blind.

In the remaining cases, the cause of blindness was, variously, detachment of the retina, glaucoma, retinitis, nystagmus, and keratoconus (in a woman, the reason for whose admission to such a school remains obscure).

Woods' classification can usefully be compared with the etiologic classification of 500 cases of blindness treated at the Valley Forge General Hospital Eye Center during 1944 and 1945. In 333 of these 500 cases, the blindness was the result of combat-incurred injuries. In 61 other cases, it was the result of accidental injuries, 46 of which were due to such causes as dynamite explosions, land-mine explosions, and boobytraps. In the 103 cases of blindness from disease, syphilis was part of the picture in only 4 instances, which is a decided contrast to the 30 cases (more than 9 percent) for which this disease was responsible in Woods' 325 cases in World War I.

Courses of instruction and training. The professional and teaching staffs at the Evergreen School were for the most part recruited from staffs of institutions for the blind throughout the country. There were numerous volunteer instructors. A reception home was established in Baltimore for the relatives of the patients, and a special effort was made to have a parent or other close relative accompany the patient to the school and remain with him until he was installed and until the teaching staff had assumed the responsibility for him. The ideal was to maintain a ratio of 1 teacher to 1 student.

The course of instruction varied in its length, and also in its elements, according to the need of the individual student. The basic constituents included Braille, English, typewriting, and handwriting, followed by instruction in the vocation selected, the choice of which was made under guidance. Vocational training included poultry raising and dairy farming; commerce, with storekeeping a prominent part of the training; industry, with special emphasis on automobile repairing; vulcanizing; cigar manufacturing; tree repairing; novelty work; weaving; woodworking; bookbinding; basketmaking; and such business courses as life-insurance salesmanship. All phases of salesmanship, purchasing, and store management were taught in a model store established at the school. Later, several chain stores on the same model were established in various localities and were controlled and financed by the Red Cross Institute for the Blind.

Bowling, swimming, canoeing, dancing, and other forms of athletics and recreation were part of the recreational program.

INITIAL PLANNING FOR THE REHABILITATION OF THE BLINDED IN WORLD WAR II[2]

Until June 1944, when a section of ophthalmology was created in the Surgery Division (later the Surgical Consultants Division) of the Office of the Surgeon General, the responsibility for the rehabilitation of blinded casualties was delegated to the Reconditioning Division of that office.[3] Various Federal and civilian agencies, however, were interested in the rehabilitation problem, as was the Subcommittee on Ophthalmology, Division of Medical Sciences, National Research Council,[4] acting for the Committee on Medical Research, Office of Scientific Research and Development.

At the outbreak of World War II, two bodies within the structure of Federal agencies were concerned with the rehabilitation of the blinded; namely, the Veterans' Administration and the Vocational Rehabilitation Service for the Blind, in the United States Office of Education, Department of the Interior. Among the multiple nongovernmental agencies were three of national prominence; namely, the American Foundation for the Blind, New York, the Association of Workers for the Blind, Winnetka, Ill., and the American Association of Instructors for the Blind, Lansing, Mich. The multiplicity of organizations interested in the blind is evident in the fact that the American Foundation for the Blind had as one of its activities the publication of a comprehensive directory of these organizations. It also published a magazine, Outlook for the Blind.

Planning in 1942

In May 1942, the chief of Services for the Blind, United States Office of Education, called to the attention of The Surgeon General the fact that many of the soldiers blinded in World War I had done nothing since that war but receive pensions from the Government.[5] His office was anxious that errors which had occurred in attempts at vocational guidance and training in the past should be avoided in the present conflict and that young men blinded in World War II should be so trained that they could continue their contribution to the welfare of their communities and the Nation. In line with this objective, two requests were made: (1) That a conference be held on the subject of blinded casualties; and (2) that all instances of serious eye injury in the Armed

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[2] (1) Report, Maj. Henry B. Gwynn for Col. Augustus Thorndike, 29 Aug. 1945, subject: The History of the Rehabilitation of the War Blinded Within the Reconditioning Program of the Army Service Forces (19 August 1943-30 June 1944). (2) Report, Col. Derrick T. Vail, MC, for The Surgeon General, 23 July 1945, subject: The Army Blind Program, History, Development and Present Status.

[3] (1) Memorandum, Maj. Walter E. Barton, MC, for Col. Arden Freer, MC, 13 May 1943, subject: Steps Taken to Organize a Rehabilitation Service for the Newly Blinded. (2) Memorandum, Lt. Col. Walter E. Barton for Col. Derrick T. Vail, 29 May 1945, subject: Early History of the Development of the Blind Rehabilitation Program.

[4] Minutes of the meeting of Subcommittee on Ophthalmology, National Research Council, Division of Medical Sciences, acting for the Committee on Medical Research of the Office of Scientific Research and Development, 4 Sept. 1942.

[5] Letter, Joseph P. Chunk, Chief, Services for the Blind, U. S. Office of Education, Federal Security Agency, Washington, D. C., to The Surgeon General, 5 May 1942 subject: Blinded Service Personnel.

Forces be reported directly to the Services for the Blind, United States Office of Education.

In reply to this letter,[6] The Surgeon General called attention to the fact that the current policy of the Federal Board of Hospitalization, approved by the President, was that facilities of the Veterans' Administration should be utilized by members of the Armed Forces who had incurred disabilities in service and whose physical rehabilitation by the Army and Navy was not feasible. Until that date (May 1942), the number of blinded casualties had been minimal, but thereafter it would be the practice of the Army to transfer blinded soldiers to Veterans' Administration installations as promptly as possible. It was therefore recommended that the plan proposed by the chief of Services for the Blind, United States Office of Education, be submitted to the director of the Veterans' Administration, under which agency it was thought that reeducation of the blinded could best be instituted and carried through to its conclusion.

Appointment of committee from the Office of the Surgeon General. In June 1942, in response to the interest in the welfare of the blinded expressed by Congress and by the Secretary of War, Col. Arden Freer, MC, acting chief of the Professional Administrative Service (in the absence of Brig. Gen. C. C. Hillman, chief of the service, who was then overseas), appointed an informal committee to look into this matter. The committee consisted of himself as chairman; Brig. Gen. Fred W. Rankin, chief of the Surgical Consultants Division; Col. B. N. Carter, MC, Surgery Division; and Maj. (later Lt. Col.) W. E. Barton, MC, then of the Neuropsychiatric Division and later director of the Reconditioning Division when it was established in August 1943.

The purpose of this committee was the investigation of existing agencies for the care of the blind, both in the United States and overseas. It was then, as previously noted, the plan that rehabilitation of blinded soldiers should be carried out by the Veterans' Administration. Nonetheless, it was deemed imperative that retraining programs should be established in specially designated Army hospitals, where the social adjustment of the blinded soldier to his handicap could be undertaken while he was still receiving medical treatment.

This committee met informally on several occasions to discuss the responsibilities of the Army Medical Department in the establishment of a rehabilitation program for the blinded soldier. Activities in this field, however, soon became the major responsibility of Major Barton, who continued to study the techniques of management of the blind from existing agencies and from the literature. Particular attention was paid to the United States experience in World War I, which had been unsatisfactory in numerous respects (p. 162), and to the World War I policies of the Canadian National Institute for the Blind and of St. Dunstan's in England. Valuable information was secured

[6] Letter, The Surgeon General (Col. H. D. Offerth, MC, assistant) to the chief, Service for the Blind, U. S. Office of Education, Federal Security Agency, 6 May 1942, subject: Blinded Service Personnel.

from the American Association of Workers for the Blind; the American Foundation for the Blind; the National Society for the Prevention of Blindness; the National Library for the Blind; the Vocational Rehabilitation Service for the Blind in the Office of Education, Department of the Interior; the Perkins Institute; and the Subcommittee on Ophthalmology of the National Research Council. Conferences were also held with the Rehabilitation Service, Veterans' Administration, and the American Occupational Therapy Association.

Planning in 1943

Resolution of Federal Board of Hospitalization.[7]—The philosophy that no blind problem would exist as long as the pension was great enough was somewhat difficult to overcome, but it was never accepted by those responsible for the care of the blinded in World War II.

At a meeting of the Federal Board of Hospitalization held in Washington 3 February 1943, the following resolution was drafted:

Whereas at a meeting of the Federal Board of Hospitalization on February 3, 1943, the Surgeon General of the Army outlined to the Board the problem that will arise relative to the care of the blind as the result of the present conflict; and while it is difficult at the present time to predict the number of such cases that may result, it is the feeling of the Board that a decision should be made early as to what steps should be taken to make adequate facilities available to meet this very important problem.

After careful and full consideration of the matter, the Board is of the opinion that cases arising in the Army and the Navy should first be given the necessary immediate hospital treatment by those services. During the period of medical treatment the blind veteran will be taught how to take care of his personal needs. In this first period the veteran should be encouraged to feel that there is still much that he will be able to do and that life from that point forward will not be as bleak as it may appear at the outset.

Following this initial period and at such time as in the judgment of the Surgeons General of the Army and Navy [sic], the blind will then be turned over to the Veterans' Administration, which agency will provide suitable facilities for the necessary further treatment and training of the blind veterans, and

Whereas, the Board feels that if an effort is made at the outset to assure the blind that they still have a rightful place in the family and the community and if properly encouraged, they will be able to lead active lives in spite of blindness and be able to carry on useful service to themselves and their communities, and

Whereas the Board also feels that full advantage should be taken of the experience had at St. Dunstan's and other similar institutions that have been successful in the treatment and care of the blind, therefore, be it

RESOLVED, that the Federal Board of Hospitalization recommends to The President that the foregoing policy be approved, and that the Veterans' Administration be charged with the responsibility of making provision for suitable facilities for the care and training of the blind.

Plan of Subcommittee on Ophthalmology, National Research Council.—Specific recommendations for the rehabilitation of blinded soldiers were made

[7] Resolution drafted by the Federal Board of Hospitalization 3 Feb. 1943. (This was never adopted, according to a note from assistant to chief, Hospital Branch, Bureau of the Budget, 20 Oct. 1950.)

by the Subcommittee on Ophthalmology, National Research Council, and were submitted to The Surgeon General on 19 April 1943.[1] The substance of these recommendations was as follows:

1. The social rehabilitation of the blinded casualties in the Armed Forces was to become a function of the Veterans' Administration, to be handled by the Division of Educational Rehabilitation, not the Medical Division.

2. The Veterans' Administration should establish a guesthouse for the blind. This would be a central institution for housing and educating blinded casualties until they were prepared to return to their home environment and were capable of self-independence.

3. This central institution was to be notified as soon as a blinded casualty was admitted to one of the specialized hospitals designated for the care of the blind, where his physical rehabilitation would be completed and a representative of the social or educational staff of the Veterans' Administration would at once make contact with him. Army and Navy psychiatrists would aid in the mental readaptation undertaken by the Veterans' Administration.

4. Upon completion of physical rehabilitation, the blinded casualty would be discharged to the Veterans' Administration and transferred to the central guesthouse, where his educational process would be continued, as rapidly as possible, along the lines decided upon by the Veterans' Administration representative, the psychiatrist, and other members of the educational and social staffs of the hospital in conference with the individual himself. Education was to be carried out as rapidly as possible, to avoid "the development of the institutional habit."

5. When the patient was returned to his home community, college, or whatever environment had been decided upon, he was to be helped to reestablish himself there by a member of the social staff of the Veterans' Administration or by some local agency designated for the purpose. Contact would still be maintained with him so that educational benefits should not be cast off. He would be returned to the central guesthouse for short periods only, as might be necessary.

6. The entire process of adaptation and education was to be carried out on an individual basis, and the guesthouse was to be made so attractive from every standpoint that the patient would have no desire to leave it before completion of the necessary course.

The Subcommittee on Ophthalmology, National Research Council, added to these recommendations specifications concerning the size and physical features of the central guesthouse, its equipment, and its staff.

Designation of special hospitals for the care of blinded casualties.—On 28 May 1943, War Department Memorandum No. W40 14 43 designated Valley Forge General Hospital, Phoenixville, Pa., (fig. 17) and Letterman

[1] Letter, Dr. Lewis H. Weed to The Surgeon General, 19 Apr. 1943. Enclosure: Statement on Rehabilitation of the Blind. Prepared by the Subcommittee on Ophthalmology, National Research Council, Division of Medical Sciences, acting for the Committee on Medical Research of the Office of Scientific Research and Development.



FIGURE 17. View of Vaduz Estate, General Hospital

General Hospital, San Francisco, Calif., as special hospitals for ophthalmic surgery and for the treatment of blinded casualties. Valley Forge General Hospital continued to operate in this capacity throughout the war. On 25 August 1944, the blinded casualties at Letterman General Hospital were transferred to Dibble General Hospital, Menlo Park, Calif., which thereafter served as a center for blinded casualties.

When the special hospitals were designated for the treatment of the blinded in May 1943, it was the plan of the Navy to centralize its blinded casualties in the Philadelphia Naval Hospital,[9] while the Veterans' Administration planned to receive patients referred to it for rehabilitation at the Veterans' Administration Facility (Hines), Maywood, Ill.[10]

Both Army general hospitals originally designated as centers for the treatment of the blinded also functioned as centers for plastic surgery. This was an important consideration, since blinded men frequently had disfiguring injuries of the face. The fact that both installations were general hospitals was equally important, since it made possible the treatment of associated injuries, which were present in a large proportion of cases. Only if the blinded men had injuries which required specialized treatment at other centers did it prove impractical to transfer them at once to the hospitals designated for treatment of the blinded.

The Surgeon General had advised the commanding officers of the specialized centers for the blinded on 12 March 1943 of the future designation of these hospitals and of the necessity of the staff's familiarizing itself with principles of rehabilitative care.[11] On 10 May 1943, a letter was dispatched from The Surgeon General to the commanding generals of all service commands,[12] requesting them to report at once the names and locations of blinded casualties within their commands. Civilian agencies assisted in the identification of casualties who had already been separated from service. Circular Letter No. 112, Office of the Surgeon General, 8 June 1943, gave further instructions for the channeling of blinded casualties to the special centers.

As time passed, it became evident that the policy of transferring blinded casualties to the specialized centers was not uniformly followed; the chief reason was the desire to complete the treatment of complicating wounds. Letters to the commanding generals of the various service commands on 26 February 1944 [13] reiterated the Army policy in regard to these casualties and contained the reminder that blinded casualties could not be discharged from any hospitals

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[9] Minutes of meeting of Subcommittee on Ophthalmology, National Research Council, Division of Medical Sciences, acting for the Committee on Medical Research of the Office of Scientific Research and Development, 31 Mar. 1943.

[10] Letter, Frank T. Hines, Administrator, Veterans' Administration to Dr. Lewis H. Weed, 28 Apr. 1943, subject: Disposition of War-Blinded Within Veterans' Administration.

[11] Letter, The Surgeon General to Commanding Officer, Valley Forge General Hospital, Attention: Chief, Medical Branch, 12 Mar. 1943, subject: Care of Blinded Casualties.

[12] Letter, The Surgeon General to Commanding Generals, All Service Commands, 10 May 1943, subject: Blinded Casualties.

[13] Letter, The Surgeon General to Commanding General, Headquarters, Seventh Service Command, 26 Feb. 1944, subject: Rehabilitation of the Blind.

except those specifically designated for the care of the blind. Thereafter, the policy was followed with almost complete uniformity.

On 1 July 1943, The Surgeon General sent a memorandum [14] to the Commanding Officer, Valley Forge General Hospital, in which was outlined the steps taken to organize a rehabilitation service for the newly blinded. In this memorandum, which was followed 11 September 1943 by Circular Letter No. 162, Office of the Surgeon General, it was pointed out that the initial program which, in general, was modeled on the work of St. Dunstan's in England and of the Canadian National Institute, was based on three principles:

1. Contact with the newly blinded soldier as soon as possible after his injury, so that he might begin treatment with the best possible psychologic conditioning.

2. The establishment of two hospital units equipped and staffed with trained personnel adequate to supply medical and surgical care and to train the newly blinded in the essentials of self-care and general orientation. The intention was that the staff should include experienced instructors who could teach enlisted personnel proper methods for the care of the blind; teachers of Braille and of other special techniques; and a trained occupational therapist.

3. Continuation of social rehabilitation and vocational training for the blinded on their discharge from Army hospitals, under the jurisdiction of the Veterans' Administration at Hines Hospital, Maywood, Ill.

This memorandum also contained detailed instructions for securing personnel, together with an outline of their qualifications and duties; instructions for securing equipment and supplies; and certain general principles of management of the newly established centers for the blind.

DEFINITIVE PLANNING FOR REHABILITATION

The designation of Valley Forge and Letterman General Hospitals as specialized centers for the care of blinded casualties had fully provided for these men as long as they were in need of medical and surgical care. By the middle of October 1943, however, a large number of blinded soldiers in these hospitals had received all the medical and surgical care they needed but they were far from being adjusted to the handicap of their blindness. The hospitals had no authority to retain patients beyond the time at which treatment was completed, but it was evident that for blinded casualties a gap existed between this period and their entrance upon planned vocational training under the auspices of the Veterans' Administration. This Administration had no facilities available for specialized rehabilitation, and the only solution of the problem seemed to be to discharge blinded casualties to their homes, where they would not, of course, receive the specialized attention they might need.

[14] Letter, Surgeon General to Commanding Officer, Valley Forge General Hospital, Attention: Chief, Medical Branch, 1 July 1943, subject: Rehabilitation of the Blind in Army Hospitals.

The need for an institution for specific vocational rehabilitation of blinded casualties in the Armed Forces had been discussed by the Subcommittee on Ophthalmology of the National Research Council at a meeting held 13 July 1943, and a recommendation had been made that a meeting to further this project be arranged and be attended by the Subcommittee on Ophthalmology, the Administrator of the Veterans' Administration, and the Director of the Federal Security Agency. This subcommittee had previously submitted to the Administrator of the Veterans' Administration the detailed plan which it had formulated for the rehabilitation of blinded casualties.[15] At a meeting of the subcommittee held 12 October 1943, it was noted that this plan had been approved in principle by the Army and Navy Medical Departments but that the Veterans' Administration had taken no action upon it.

At the 12 October meeting, Col. Derrick T. Vail, MC, senior consultant in ophthalmology in the European Theater of Operations, outlined the functions and achievements of St. Dunstan's in England and pointed out the great advantages of setting up on the same basis an Army installation in the Zone of Interior. Colonel Vail admitted that the paternalism practiced by St. Dunstan's would perhaps not be desirable for all handicapped war veterans, though it had worked extremely well in the "small world" of the blind. He emphasized the invaluable esprit de corps evident at St. Dunstan's and listed the advantages of the establishment of such a central institution in the United States, including (1) the avoidance of difficulties which the older institution had already overcome; (2) simplification of administration; (3) economy in personnel and equipment; (4) the inspiration furnished to patients by men who had preceded them under the same handicap; and (5) the possibility of encouraging men to remain at the institution for the full length of time required for proper training.

The Subcommittee on Ophthalmology at this meeting urged the establishment, by the Rehabilitation Division of the Veterans' Administration, of an independent institution for the training of blind veterans.

Meantime, the President had requested from the Secretary of War a detailed report of what was being done in the field of rehabilitation of disabled men and women. In response to this inquiry, The Surgeon General forwarded to the Assistant Chief of Staff, G–1, a memorandum outlining the rehabilitation services in the Medical Department of the Army.[16] Section 3 of this report emphasized the necessity for an elaborate program of preparation for blinded casualties before their discharge to a Veterans' Administration installation for vocational training.

The President, on receipt of these findings, appointed a Committee on Rehabilitative Measures, which made the following recommendations for

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[15] See footnote 8, p. 155.

[16] Memorandum, Maj. Walter E. Barton (for The Surgeon General) for Assistant Chief of Staff, G–1, 2 Aug. 1943, subject: Rehabilitation Services in the Medical Department of the Army.

measures to be carried out by the War and Navy Departments for the benefit of blinded servicemen before they were discharged from the service:[17]

1. All blinded casualties should be retained in service hospitals until they had received maximum benefits from hospitalization.

2. Social-adjustment training should be begun as soon as possible after it had been determined that the patient would be blind and should be completed before he was discharged from service.

3. The blinded casualty, before his discharge from the service, should be fully informed through the Veterans' Administration concerning the course of vocational rehabilitation to be pursued by him and his ultimate vocational objective.

4. The length of the soldier's stay in hospital should be as brief as compatible with full social adjustment. Long continued residence in institutions for the blind was deplored, though it was acknowledged that a short association with other veterans having the same disability would be of value to newly blinded veterans.

These recommendations were signed by the Secretaries of War and the Navy, the Chairman of the War Manpower Commission, and the Administrator of Veterans' Affairs and were approved by the President 8 January 1944.

The social-adjustment training for blinded personnel of the Armed Forces was made the responsibility of the Army and Navy in War Department Memorandum No. 40–44, dated 12 September 1944. In this memorandum, explicit instructions were given for the preliminary training of such personnel at one of the eye centers and, when maximum hospital benefit had been attained, for their transfer to Old Farms Convalescent Hospital (Special), Avon, Conn. It was also explicitly stated that all Army personnel who had been blinded would be retained in service until their social-adjustment training was such as to enable them to undertake vocational rehabilitation under the provisions of Public Law 16, 78th Congress, or until they had made the best adjustment of which they were capable. Under no circumstances were blinded Army personnel to be retired or discharged without specific authority of The Surgeon General before the attainment of these objectives.

General Program

The blinded individual, whether or not his disability is service connected, must adjust his life to new circumstances. Some of these circumstances affect his immediate existence. Others diminish in importance as he adjusts to his new environment. Some, if his training has been adequate, cease to be problems.

Those in charge of the program of rehabilitation of the blinded in World War II planned the program in three phases: (1) A routine for daily living,

[17] Summary and recommendation of the President's Committee on Rehabilitative Measures to be carried on by the War and Navy Departments with respect to blinded servicemen prior to discharge from the service, 8 Jan. 1944.

which was the primary phase; (2) preparation for a new vocational program, which was the intermediate phase; and (3) vocational training, which was the advanced phase. Orientation permitted the blinded man to know the scope of the complete program and stimulated him to further progress. Each successive phase offered more and more independence and was designed to prevent complacency on the one hand and undue dependence on instructors on the other. The complete program was thus designed as a means to a liberating end.

Primary period.—The primary period of training was recognized as the most important. In it, with adequate guidance, the blinded man could avoid acquiring undesirable habits of the blind (blindisms), could overcome frustration, and could gain skill and confidence in living which would keep him a normal member of society. The newly blinded man often has conceived faulty notions and is inclined to think that his life in the future must be completely changed and must be divorced from most of his previous activities. To overcome these conceptions, motivations was stressed in the initial period of training. The routine of a self-sufficient daily life was begun at once, and the man was trained to take care of himself as the proper mode of approach to a new life.

To facilitate training in this primary period, certain specific plans were adopted which would procure speedy adjustment to normal living. Initial training was confined, as far as circumstances permitted, to a single instructor, an enlisted man, with the cooperation of the blind consultant. The length of the training period was determined by the degree of adjustment. It naturally depended upon the amount of medical and surgical treatment required, but 30 days was set as a desirable time. A furlough was granted whenever practical at the conclusion of the primary period to permit the patient to use the knowledge and independence he had gained and to foster his self-confidence by a successful social experience.

Two reports were filed at the conclusion of the training period and were made part of the patient's rehabilitation file: (1) A copy of the initial interview prepared by the consultant; and (2) a report of training by the instructor, which included specific suggestions for the instructors who would continue the training.

Intermediate period.—During the intermediate period, the blinded man, now that he had achieved a degree of personal independence as the result of training in the primary period, was offered academic training in the basic skills necessary for later vocational training and was provided with social contacts. This period of training included—

1. Academic training in Braille, typing, training in workshops, physical education, and other courses. Provision was made for the establishment of definite levels of achievement in the academic subjects, and an adequate testing program was established for other courses. Class instruction was substituted for individual instruction as soon as possible, the stimulus of purposeful group work being regarded as desirable.

2. Speech work, to correct any tendency toward poor speech patterns.

3. Discussions and refresher classes.

4. A varied social program, with emphasis on correct social etiquette.

During the intermediate period, biweekly progress reports were added to the blinded man's rehabilitation file.

Advanced period.—During this period of training, it was assumed that the blinded man, having completed the first two stages of training, was being prepared for his future vocational life. Emphasis was therefore placed upon—

1. Orientation to a complete vocational program;

2. Vocational specialization for higher educational, professional, or business training; and

3. Information concerning the facilities of the Veterans' Administration, the national agencies for the blind, and the state and local agencies for the blind.

Guide dogs.—Shortly after the establishment of the program for the rehabilitation of the blinded, the Seeing Eye and other organizations serving the civilian blind expressed a willingness to give priority to blinded veterans in the provision of guide dogs and to train the men in their use at no cost or at a nominal fee. One of the agencies had in its agreement a provision to replace the dogs without additional cost. In 1944, legislation was passed by Congress providing for the expenditure of up to a million dollars for securing guide dogs for men blinded in service.

Provision of guide dogs was not, however, made part of the program of the rehabilitation of the blinded. It was thought that if a man were to be given a dog before he had received complete training himself and had become independent from the standpoint of travel, he would be likely to become so dependent on the dog that he would not achieve the requisite self-reliance for his new mode of life, which it was the objective of the training program to make as normal as possible.

CRITERIA OF ADMISSION TO SPECIALIZED CENTERS

In his analysis of the activities of the Evergreen School, Woods [18] had pointed out that policies of admission had not always been clear cut and that some of them had been of questionable wisdom. Some patients had been received who were merely visually handicapped, not blind. Men were admitted with more than 1/10 vision "if the degree of defectiveness prevented them from successfully pursuing the courses in which they had previously been placed elsewhere" and they were placed in a "sight-saving class." Among 43 men in this category, a number had useful vision. Several of them, however, had previously been at other installations which had been unable to achieve any results with them. When they were admitted to Evergreen School they

[18] See footnote 1 (2), p. 147.

proved unable to absorb the education offered there and in fact showed no desire to do so. They were constant troublemakers, they interfered seriously with the discipline of the school and the morale of other students, and in the main they reflected discredit upon the institution.

Woods also called attention to the questionable wisdom of admitting to such a school men with bilateral hysterical amblyopia. Those in this category at the Evergreen School were rated as blind, received a proportionately large pension, "and thereupon their blindness became firmly fastened to them for life." Many of the men in this group were still at the school when it was closed in 1925 and had to be disposed of to psychopathic and other Veterans' Administration institutions (p.150). They also tended to be troublemakers and could more properly have been placed under the care of psychiatrists originally.

Definition of blindness.—In view of these and other policies which had proved unwise in the management of the blinded in World War I, the Subcommittee on Ophthalmology of the National Research Council occupied itself early in World War II with a practical definition of blindness. At the meeting held 4 September 1942,[19] the opinion was expressed that instead of the definition in use by the Veterans' Administration, that is, visual acuity of 5/200 and total loss of light perception, which is total blindness, the standards of the American Medical Association for industrial blindness would be more practical. These criteria provided for vision of 20/200 or less in the better eye or a corresponding limitation of the visual fields.

On 13 July 1943,[20] the Subcommittee on Ophthalmology of the National Research Council approved the following definition of blindness and recommended it to the Armed Forces for adoption: Central visual acuity of 20/200 or less in the better eye with correcting glasses; or visual acuity with correcting glasses of more than 20/200 but less than 20/40 if a field defect existed in which the peripheral field had contracted to such an extent that the widest diameter of visual field subtended an angular distance no greater than 20°.

The definition of blindness finally adopted by the War Department [21] provided for "central visual acuity * * * 20/200 or less in the better eye with corrective glasses; or central visual acuity with corrective glasses * * * more than 20/200, but less than 20/40, if there is a field defect in which the peripheral field has contracted to such an extent that the widest diameter of visual field subtends an angular distance no greater than 20 degrees." After this definition had been adopted, blinded casualties were admitted to the specialized centers for the blind only when they met one or the other of these criteria.

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[19] See footnote 4, p. 152.

[20] Minutes of meeting of Subcommittee on Ophthalmology, Division of Medical Sciences, National Research Council, acting for the Committee on Medical Research of the Office of Scientific Research and Development 13 July 1943.

[21] War Department Memorandum No. 40-44, 12 Sept. 1944, subject: Social Adjustment Training for Blinded Service Personnel of the Armed Forces.

PROGRAM AT VALLEY FORGE GENERAL HOSPITAL[22]

Although variations within the framework of the general plan were permitted at each installation designated for the care of the blinded, the policies and principles employed were basically identical at each. A description of the program at a single installation (Valley Forge General Hospital) will therefore serve as a description of the whole program.

Facilities

In addition to the usual medical facilities and the facilities and equipment necessary for special ophthalmic care, the center for the blinded at Valley Forge General Hospital was equipped with special facilities for the rehabilitation program. These included:

1. Five classrooms, each large enough to accommodate an instructor and two students; an enclosed porch large enough to accommodate an instructor and 10 students; a combined music storage and classroom large enough to accommodate various musical instruments, an instructor, and a student; and a dayroom, not in constant use, large enough for an instructor and two students.

2. Facilities for reconditioning in the hospital and nearby. On the post, there was a large gymnasium, fully equipped. The Young Men's Christian Association swimming pool at Norristown was used during the winter, and a private swimming pool at Malvern was used during the summer. The golf club and a recreation center (used for bowling) were available at Phoenixville, and the riding academy at Valley Forge Park, the Bachelor's Barge Club, and the University of Pennsylvania Field House at Philadelphia could be used for the appropriate purposes.

3. An enclosed porch, four dayrooms, the Red Cross auditorium and lounge, and the post theater for recreation. Many outside organizations also contributed to the recreational program.

4. Administrative facilities, which were ample.

5. Transportation facilities. These included the post buses and field ambulances, the conveyances of the Red Cross Motor Corps, coach lines, and railroads.

6. Occupational therapy facilities. These included, in addition to storage rooms, a plaster room; a pottery room; a woodworking room; and rooms for weaving, caning, and leatherwork.

7. Teaching equipment. This included portable and standard typewriters, desks and chairs, Braille instruction books, Braille writers, radios, musical instruments, and a recorder. Part of this equipment was supplied by the Red Cross.

8. Equipment for occupational therapy. This included floor looms for

[22] A report on the operation of a specialized center for the treatment and rehabilitation of blinded casualties. Annual reports, Valley Forge General Hospital, Rehabilitation of the Blind Program, 1944–45.

rugs, table looms, kilns for clay firing, handtools for woodwork, and an electric jigsaw.

Personnel

Educational and rehabilitation aides to the blind who qualified under civil-service regulations were required to possess the following training and qualifications: (1) Personal characteristics necessary for successful teaching; (2) a bachelor's degree from a college or university of recognized standing, granted upon the completion of a 4-year course; (3) 10 semester hours of social work in a graduate school of social work; (4) 4 semester hours (or the equivalent) of courses in methods of teaching; and (5) a year or more of successful experience as a teacher of the blind, including the teaching of Braille.

The duties of these aides, which were carried out under medical supervision, were as follows: (1) To aid in the social adjustment of the newly blinded, social adjustment being interpreted to include elementary training in self-care and encouragement for independence and preservation of life as a part of the social group; (2) to teach various substitute skills which would minimize the handicap of blindness, including instruction in Braille reading and writing, in the use of Braille watches, games and other equipment, and in the use of the typewriter, the talking book, and the radio as a means of reorientation; (3) to further the psychologic adjustment of the blinded individual and to stimulate in him a desire for a life of usefulness, social intercourse, recreation, and entertainment; and (4) to assist in the preparation of the patients' case histories and to keep such records of their progress as might be required.

These positions were created in 1943, and personnel to fill them were recruited from existing agencies for the blind, in cooperation with the Civil Service Commission and the Civilian Personnel Division of the War Department. All military rosters were reviewed, and professional and lay periodicals cooperated in the endeavor.

By October 1943, there were, at the Valley Forge General Hospital, 16 blind patients to whom 2 instructors were assigned. One was a blind Braille teacher, and the other had worked as a job-placement officer in the Vocational Rehabilitation Services for the Blind, United States Office of Education. Of the 16 patients, some had completed the necessary medical and surgical treatment, but they could not be discharged from the hospital because they were not yet independent. They had no training for any occupation. The craftshop of the Red Cross was available to them, but none of the workers in the shop had had any experience with the blind. Apart from the two instructors mentioned, none of the other personnel of the hospital had had previous experience with blinded persons or any contact with them. The morale of the blind patients was low, and they were frank in their expression that the future held no hope for them.

By January 1944, however, the nucleus of a competent and experienced staff had been gathered and a definite, scheduled program of activities had

been formulated, of which the program of orientation was not the least part. In December of the previous year, weekly meetings of all connected with the blind program had been instituted, and these regular conferences soon proved of great importance in coordinating the efforts of the staff. Daily inspections were carried out to be certain that correct teaching methods were being employed.

At the end of 1944, the personnel of the Valley Forge General Hospital Eye Center consisted of a chief of section with the rank of lieutenant colonel; a ward and administrative officer with the rank of captain; an occupational-therapy officer who was a first lieutenant in the WAC; 2 educational and rehabilitation officers, who were second lieutenants in the WAC; 9 occupational-therapy aides, all enlisted WAC's; 17 instructors, who were enlisted men in various grades; 5 blind educational and rehabilitation aides; 2 full-time volunteer readers; and civilian clerks and stenographers. The full staff had been available only since June of 1944; previously there had been no educational and rehabilitation officers, and other personnel had been limited.

An ideal table or organization for 250 blinded men was estimated as calling for 85 men, in the following grades:

Grade II: 2 men, 1 a supervisor of plans and training and 1 a supervisor of enlisted men.

Grade III: 4 persons, including a Braille teacher, a travel supervisor, a reconditioning supervisor, and a test supervisor.

Grade IV: 16 persons, including 4 teachers of Braille, 2 teachers each for typing and music, 2 travel testers, 1 scheduling supervisor, 1 occupational-therapy specialist, 1 assistant travel supervisor, 1 assistant supervisor of plans and training, 1 assistant supervisor of enlisted men, and 1 assistant reconditioning supervisor.

Grade V: 63 persons. These men would all be technicians with special abilities, educational qualifications, and skills. It would therefore be desirable for their morale, which was always directly reflected in the service given to the patients, that they be of this grade or better.

The qualifications and personality of the staff of the eye center at Valley Forge General Hospital admirably fitted them for the positions they held, as the following illustrations will make clear.

The administrator of the rehabilitation program, in addition to his other training and experience, had held the responsible position of supervisor of the division of services for the blind in the social-welfare department of a thickly populated State. Rigorous qualifications had been set up for this position, and the man appointed to it necessarily possessed executive ability and was required to have had a large experience in institutions, industrial organization, development of training programs, private agencies, direction of blind teachers of the blind, sightsaving programs, sales of output by the blind, and similar matters.

The director of physical reconditioning, orientation, and recreation was a

college graduate with a degree in health and physical education and had done graduate work in educational psychology. He had taught at a school for the blind, been an instructor in Braille, a counselor at a boys' camp, and an instructor in physical education for both sighted and blinded men. He was certified by the American Association of Instructors of the Blind and held certificates from numerous athletic organizations and the Red Cross certificate for lifesaving.

Another member of the administrative staff, who later became director of training at Old Farms Convalescent Hospital, had been graduated from Harvard University with a bachelor's degree cum laude. He had had a long experience in work among the blind, serving as teacher, as research associate, as director of education and vocational guidance, as director of diagnostic clinics, and as director of a case-record system in various organizations. In one of his State positions, he had supervised the programs of social welfare, adult education, occupational therapy, employment bureau, medical department, psychiatric clinic, music schools, recreation, summer camps, publicity, and fund raising. In this position, he had been in charge of a training staff of 60 persons, had supervised annual expenditures of $225,000, and annually had interviewed hundreds of blind and supervised their rehabilitation.

The WAC lieutenant in charge of the hobby shop and crafts had had a 21-year experience in occupational therapy in various schools and hospitals, much of it among the blind. All her assistants in the WAC detachment had had experience in teaching handicraft or occupational therapy or both among the blinded.

One of the civilian educational and rehabilitation aides had been blind for 35 years, since she was a child of 2. She had only light perception. She was a graduate of Cornell University, had had postgraduate study at Columbia University and the New York School of Social Work, had a fine musical education as well as a business education, and had worked in various organizations for the blind and in the New York State Department of Social Welfare. Another civilian aide had been blind since she was 10 months old. She held bachelor of science and master of arts degrees, the latter in social administration. She had taught music (voice and piano) privately, had done concert and recital work, was an experienced teacher of Braille, and had done considerable casework and administrative work among the blinded. These and other blinded members of the staff were living examples not only of adequate but of superior adjustment to their handicaps.

Other members of the administrative staff, as well as numerous other staff members, were equally experienced in work among the blind and had equally high educational and other qualifications.

The enlisted men assigned to the program for the blind had the responsibility of literally teaching the blinded to take up their lives again. They oriented them in the location of beds, cubicles, wards, latrines, treatment rooms, messhalls, offices, classrooms, telephone booths, clinics, post exchange,

and other hospital facilities. They instructed them in practical methods of eating, dressing, and care of their persons and of their clothing, effects, and money. They taught them how to travel outside of the hospital. They gave them lessons in cane technique, obstacle sensation, muscular memory, and similar substitutes for vision. They trained them in manual dexterity and mechanical aptitude. Eventually, they trained them to hold positions in industrial plants in the vicinity which they had themselves surveyed.

All enlisted men were given a 12-day course of instruction in their duties, further supplemented by on-the-job training for 3 hours each week.

Good orientors were the backbone of the rehabilitation program for the blind; the success of the program depended on their proper selection. Although their tasks concerned simple and apparently obvious matters, these tasks were not simple for the newly blinded soldier. His progress had to be guided. He could not be made to do everything for himself at once; that would have caused a state of nervous tension superimposed upon the original ordeal. Yet he had to be made to increase his independence from day to day and from week to week.

The director of physical reconditioning, orientation, and recreation at Valley Forge General Hospital, 1st Lt. (later Capt.) R. E. Hoover, MAC, wrote the following practical outline of the characteristics of a good orientor:

> All kinds of men make good orientors. Good instructors of the blind derive a large part of their strength from knowledge and from traits not at all peculiar to persons who work with the blind. One excellent orientor was a truck driver in civilian life. Another was a life insurance salesman, another a musician, another a golf professional, and another a farmer. There is plenty of room in this field for a man with no particular specialty to be carried over into the field if he is used to managing things and getting things done.
>
> A good orientor must be the kind of man who can be allowed to use his own initiative to a great degree and who has sense enough not to abuse the privilege. Some orientors at Valley Forge have been successful by being always serious with the patients, others by never being serious. Each man must develop his own methods.
>
> The most successful orientors seem to get the best results by avoiding an air of proprietorship with the patient, staying in the background as far as possible, letting the patient teach himself whenever that is possible. The orientor's job is to find out what the patient wants that is constructive and then help him to get it. He must bear in mind that despite all the newspaper stories to the contrary, there is never a time when a blind man does not need somebody to be his eyes for him in certain activities. The orientor must therefore keep watch on a patient who has grown independent and make sure that he does not suffer lack of necessary aid through pride.
>
> The orientor must be careful not to add to his responsibilities by worrying over his patient. He should think for him and work for him when he is on duty and relax when he is not. Nearly every orientor some time or other reaches the point where he thinks he is the only person helping the blind. He should then have a 3-day pass.

Population

During 1944, rehabilitation services were made available to 290 blinded patients at Valley Forge General Hospital. Of these, 24 had been carried

forward from 1943. In 1944, monthly admissions varied from a low of 9 in February to a high of 47 in December.

During the year, 118 patients were separated from the program for various reasons. Of these, 79 were sent to the hospital at Old Farms, Avon, Conn., and 13 to other hospitals; 13 were discharged on Certificate of Disability; 1 died; and the remainder were taken out of the program. Four in the latter group were prisoners of war; the others had regained sufficient vision to need no further training and could be transferred to other sections of the hospital. The patients released on Certificate of Disability had been admitted by proper regulations but had regained sufficient vision to be removed from the category of blinded.

During 1945, 585 blinded casualties were admitted to the Valley Forge Eye Center, admissions ranging from a low of 20 in December to a high of 87 in May. Transfers, dismissals, and removals were in about the same proportion and for the same reasons as those in 1944.

Objectives of Program [23]

Rehabilitation of the blinded at the specialized eye centers was geared to the definition of the National Council on Rehabilitation that "rehabilitation is the restoration of the handicapped to the fullest physical, mental, social, vocational, and economic usefulness of which they are capable." For the blind, rehabilitation was regarded as a continuing process. The whole endeavor of the program was so to serve the individual as to adjust him personally to his blindness; to train him in new activities; to teach him new recreations; and to assist him in adjusting himself to his family, his friends, and society as a whole.

The program included five objectives:

1. Physical restoration. This objective implied the completion of all definitive medical and surgical treatment before the blinded man was transferred to the convalescent hospital at Old Farms, Avon, Conn., or was given a Certificate of Disability discharge because of sufficient improvement in visual acuity. Physical restoration was entirely the responsibility of the Medical Corps.

2. Mental restoration. This objective implied the stabilization of the patient whose primary disability was blindness. It included adjustment to the handicap, utilization of remaining assets, and planning for the future. In its first phase, it was the joint responsibility of the Medical Corps and the staff for rehabilitation services for the blind.

3. Social restoration. This objective implied that the patient would be aided to learn to live as nearly a normal community and family life as possible, to engage in social contacts, to care for himself personally, and to be able to

[23] See footnote 2, p. 152.

move about independently. To achieve this objective, which was the responsibility of the rehabilitation staff, it was necessary to study such environmental factors as family influences and relationships in addition to emotional balance and adjustment and avocational and recreational habits.

4. Vocational restoration. This objective implied the development of opportunities for training, both at the time and in the future, in appropriate trades, businesses, and professions. It was achieved by interviews with the patients concerning employment preferences and possibilities, contacts with persons in the vocational field, and contacts with employers. It might include the finding of temporary positions in private industries, though the emphasis was on fundamentals of training rather than actual practice. Vocational restoration was the responsibility of the rehabilitation staff.

5. Economic restoration. This objective implied the provision of opportunities for the blinded man to become self-supporting and to contribute to the economic life of the Nation. Compensation for service-connected disabilities would guarantee his economic security, but no opportunity was lost to impress the patient with a realization of his own responsibility as a citizen for a life of productive activity. This objective was the responsibility of the Veterans' Administration.

Orientation

The patient who entered Valley Forge General Hospital Eye Center was met by the medical officer and the nurse in charge of the ward to which he was assigned. A special endeavor was made to greet him cordially but casually and to allay whatever fears he might seem to have. A trained instructor was at once assigned to him.

Introductory letters.—Each blinded patient who was admitted to Valley Forge General Hospital received, from the Red Cross worker assigned to him, a letter, signed by the chief of the eye service, with an enclosure. The letter read as follows:

Dear * * * : Enclosed is a letter which contains information about your stay in Valley Forge General Hospital. It contains the answers to a number of questions which are usually asked, and it is sent to you in an endeavor to aid you during your stay here. The Red Cross worker who hands you this letter will give you more details about your hospital program and how you can participate in it while you are here. It is my desire that you feel free to ask any questions you may have about this letter because we are interested in making your stay here as helpful and constructive as possible.

The enclosure, which was entitled "Information for Patients on the Eye Service," read as follows:

You have been transferred to Valley Forge General Hospital because the Army has made special provision here for the care of eye conditions. You will have both specialized medical care and the opportunity for the beginning of rehabilitation training which can assist you to live more adequately whether with marked visual difficulty or with complete loss of sight. The responsibility for your medical care lies with the medical officer. Every

effort has been made to give you the best medical attention by physicians highly trained in the field of ophthalmology. You will be directly under the care of the ward officer. The chief of the service will keep in contact with you through him.

There are instructors here to work with you in increasing your ability to get around by yourself in the hospital and later outside the hospital, and to teach you specific techniques such as typing and Braille, reading, and writing. There are opportunities for shop work, athletics, and various recreations. All these activities are directed toward equipping you adequately for whatever work you will eventually do. The Red Cross has facilities to help you with any worries you may have during the time you are here, both through the worker at the hospital and through the Red Cross chapter at home. Passes and furloughs are governed by the same regulations as apply to all other departments in this hospital.

The length of your stay here depends on the kind of medical treatment you may need and on your progress in learning through the opportunities offered here. The decisions that will be made by your officers as to when you leave this hospital will depend in large part on the manner in which you demonstrate your capacity for living in a sighted world.

This enclosure also was signed by the chief of the eye service.

The instructor assigned to the patient, with the cooperation of a consultant, himself blinded and thoroughly adjusted to his handicap, worked intensively to orient the patient to his surroundings. At the same time, he endeavored unobtrusively to find out what the patient was able to do for himself, whether he was handicapped by other disabilities in addition to blindness, and whether his adjustment had begun to take shape correctly.

Initial instruction. If the patient was ambulatory, the instructor first acquainted him with his immediate surroundings, showing him how to find the cubicle to which he was assigned, his bed, the toilet, and the washroom. He guided him to the ward officer's and nurse's offices and the treatment room. Gradually, he enlarged the area of movement inside the hospital and on the grounds. He instructed him in the simplest methods of maintaining personal cleanliness, shaving (fig. 18), dressing, and caring for his clothes and other possessions. He showed him how to orient himself by touch at the table, beginning with opening a cereal box or shelling a hard-boiled egg and going on to more complicated procedures. He helped him with his correspondence and showed him the use of the fiber writing board for the blind. He answered all questions and encouraged the patient to ask them. In short, during this period the instructor served as eyes for the patient until the patient could be shown how to move about and do things for himself in spite of his lack of sight.

As the patient progressed in orientation, the orientor endeavored to withdraw somewhat the personal services which he had hitherto supplied. Daily contacts were maintained, and the patient understood that he might call upon the orientor when he needed him for advice or for any other service, but he also understood that the time had come for him to endeavor to test and to use the independence which he was being taught. His relationship with the rehabilitation service therefore became more formal. He sought out the administrative officer himself, whereas formerly he had been sought out, and he was taught in classes rather than individually whenever this was possible.



FIGURE 18. Blinded patient shaving.

During this period, great emphasis was put upon the amenities of life. The patient was expected to be well groomed at all times—his person clean, his face well shaved, his shoes shined, and his clothes clean and well pressed. Also, he was expected to use proper table manners, though in this respect improvement over the patient's previous social level, while it was regarded as desirable, was not insisted upon.

Travel. During the basic course of training and orientation, particular stress was put on travel, a term used for simplicity to indicate getting about on foot. Twenty-two lessons were given individually inside the hospital and the same number in town, by a uniform technique. Emphasis was placed on the development of full and intelligent use of the remaining intact senses, on good posture and good walking habits, and on courage in moving about without sight.

Lesson plans were provided for instruction in travel both inside and outside the hospital. When the courses were completed, special examinations were given to test the patient's ability. The following are typical tests:

1. The patient will leave his bed and proceed to the mess hall. Then he will travel to the PX, where he will buy a soft drink. On his return from the PX to the ward he will travel via an outside route, pausing at the workshop on the way. He will then travel from one main corridor and start down the ramp without using a cane.

2. The patient will leave his bed and proceed to the bus stop in front of the Administration Building. He will then travel to a designated spot in Phoenixville on the bus. While downtown, he will be given a test of traveling with a sighted attendant, who has followed him at a close distance during his journey. This test will consist of maneuvering curbs, turns, steps, and doorways without verbal help from the instructor. He will return to the hospital by bus, and then return to his bed.

During these tests, the blinded soldier was followed by an orientor who had specialized in this part of the program and who checked his progress in detail. The orientor gave no assistance unless some situation arose in which it was demanded for safety. If such a situation developed, the patient was regarded as disqualified, and the test had to be repeated. One of the points on which the patient was checked most carefully was his contact with the public. He was supposed to accept assistance only for guidance across a dangerous intersection and to reject all other assistance but to do so diplomatically.

A patient, returning to his home after discharge from service, en route to another hospital for additional treatment, or traveling on official business, was always escorted by a sighted enlisted man. When possible, blinded patients were moved in groups, but, if this was not practical, individual escorts were provided.

Travel aids. A blind man learning to get about by himself was taught to develop the various natural aids which the sighted person uses unconsciously; namely, sound (oral sense), touch (tactile sense), muscular sensation (kinesthetic sense), and scent (olfactory sense). These natural aids were now consciously called into play. In addition, he was taught to develop obstacle sensation, the so-called sixth sense. Of all natural aids, this is the least reliable. It lends itself readily to unconscious self-deception and varies from day to day. The blinded man was taught to employ this sixth sense but was also taught that he *could not rely upon* it except under the most carefully controlled conditions.

The blinded casualty was taught to travel with and without a cane. Instructors who taught cane techniques were themselves given a rigorous course of training while they were blindfolded and were required to test their training methods and techniques on other orientors, who also were blindfolded, before they were permitted to teach students. The reason for such care was that the cane, if properly used, was a most useful aid to the soldier when he was first blinded as well as later when he had become adjusted. It built up his self-confidence, and it kept him from developing the nervous habits sometimes known as blindisms. Nervous habits, once acquired, are extremely difficult to get rid of. A blind man who uses a cane to the fullest advantage is always recognized as a blind man, but the attention he draws to himself is favorable.

The cane used for general travel is preferably light wood and white and is approximately 45 inches long. At no time during the operation of the Valley Forge Eye Center could an adequate supply of the proper canes be secured, and many which had to be used were too short and handled clumsily. The metal cane devised by Lieutenant Hoover was manufactured too late to be generally supplied, but it is admirably adapted for a blind man's purposes because it is the proper length (approximately 45 inches), weighs only 6 ounces, is easily handled, and is resonant. The 45-inch length is most desirable be-

cause it gives protection at least one step ahead, even to a tall man. The cane serves primarily as a bumper for the blind man, but it is also useful as a probe.

Lessons in the use of the cane were carefully planned. The first included nothing but holding the cane properly (fig. 19). Then the technique of inside use was taught and finally the technique of outside use.



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FIGURE 19. Cane held in proper position.

When the cane was to be used inside, the patient was taught to hold it diagonally across the body. It could be held in either hand but ordinarily was held in the right hand. It was grasped just below the crook, which was held outward, turned down over the hand, which it thus protected. The hand was held 10 to 12 inches in front of the hip, and the cane thus extended downward and outward to within a few inches of the floor. The left-to-right diagonal line of the cane in this position covered an area as wide as the body of the user and protected him against the obstacles which are most unpleasant

to encounter. It did not protect him from obstacles suspended from the wall or ceiling or from very low obstacles in front of the foot on the side on which the cane was held.

When the cane was carried [illegible]de, the arm was dropped at the side, the elbow being so rotated that it rested firmly on the iliac crest. The cane was held by the crook, which curved downward, and was guided chiefly by the thumb and forefinger. The hand was kept close to the body and directly in front of the center. In this position, the wrist readily moved back and forth, making the cane pivot so that it described an arc before the user, touching the ground lightly on each side. When once this technique was mastered and the cane was moved in a rhythmic manner across the body with each step, always in front of the foot that was then behind, the user could be certain that it was safe to step forward on that foot.

Considerable experimentation was carried out by the Signal Corps in an attempt to develop some artificial aid which would make foot travel safer for the blind. Several models of an obstacle rangefinder were produced but were not sufficiently advanced to be of other than [illegible]ic interest.

Achievement.[21]—At the end of his period o[illegible]ion, the blinded patient was expected to get about the hospital alone, wit[illegible]id without a cane; travel without fear with other people; get in and out of automobiles, buses, and trains; go up and down the stairs and up and down escalators; go through revolving doors; walk along unfamiliar streets by asking and following directions; and explore unfamiliar terrain by using his cane to guide him. Many men, as their self-assurance increased, began to take trips by themselves when they had passes and furloughs. In fact, once the period of general orientation had been completed, it was found to be good psychology to grant the soldier a furlough. Absence from the hospital permitted him to put into practice such abilities as he had mastered and stimulated his desire to continue with the broader program to follow.

Multiple disabilities. Blinded men with multiple disabilities were placed under the general supervision of a chief orientor who was permitted considerable latitude for the exercise of independent judgment. All blinded men who had artificial limbs or who needed them were assigned to him. He saw that they were referred to the proper services for treatment; that their limbs were fitted, refitted, or adjusted as necessary; and that they had individual attention in instruction in eating, dressing, using the toilet, and getting about the hospital. The training program for patients with these and other handicaps was entirely individualized. Patients who were deaf or who had lost part or all of a hand or hands were specially handicapped, since the senses of hearing and touch are so important to blinded persons.

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[21] The personal experience of one blinded casualty is described in a letter written to the consultant in ophthalmology in the Office of the Surgeon General (appendix B, p. 557).

Guidance

One of the newly admitted soldier's first contacts was with a vocational counselor (a former Army officer blinded during the war) who explained the purpose of the program, described the hospital, inquired into the patient's vocational interests and hobbies, explained National Service Life Insurance privileges and Federal rehabilitation legislation, and in successive interviews assisted the patient to meet his personal problems objectively and to plan a solution for them.

New patients were also promptly referred to one of the educational and rehabilitation aides, two of whom were themselves blind. Until they were fully adjusted to their environment and hospital life, the patients remained under the supervision and care of these aides.

It must not be inferred, however, that guidance work was limited to these contacts. Definite and constructive work was carried out by all the Medical Corps officers, including the chief of section and his assistants, and by the ward officers, all of whom were specially trained in work with the blind. In addition to the individual assistance given to each patient, group meetings were held at which problems confronting the blind were discussed and at which solutions for them were proposed. These meetings were conducted by members of the staff or by persons brought in from outside who were prominent in work with the blind.

Physical Reconditioning

The physical-reconditioning program for the blinded at Valley Forge General Hospital began to function in May 1944. It was necessarily based on the consideration that soldiers would be in residence in the hospital for comparatively short periods of time. The primary function of the program was to prepare the newly blinded men to live in their own communities and to participate as fully as possible with sighted persons in normal recreational activities. There could be no argument over the importance of getting the blinded man into the best possible physical condition, or, if his physical status had deteriorated during his period of hospitalization, of restoring him as nearly as possible to the sound state of physical health in which he must have been to be inducted into service.

At the initiation of the program, it was thought that track would be a good activity, and efforts were directed toward seeking a location for a track. Upon further consideration, however, it seemed best to forego this activity at the beginning of the rehabilitation program, and all efforts were concentrated on the activities which could be performed alone and as individuals in the home or in the gymnasium.

Especially popular in the gymnasium were rowing machines, stationary bicycles, wall pulleys (fig. 20), punching bags, and other remedial equipment. Calisthenics were also popular. They were usually patterned and were always

repeated in the same order, so that the men might learn to perform them in their own rooms or homes. In some instances, shooting baskets, the horizontal ladder, the side and long horse, and the flying ring were also used in the gymnasium.

Wrestling, which is ordinarily an excellent sport for blinded men and one in which they can compete on even terms with sighted opponents, was not pursued, chiefly because the patients were for the most part too recently ambulatory for such a strenuous activity.

Indoor shuffleboard, darts, and archery were all popular. The archery target was made of three pieces of steel, a large piece, a smaller piece, and a still smaller piece, which represented the bull's eye. All were hung from



FIGURE 20. Blinded patient exercising with wall pulley.

chains on the same rack. Reinforced arrows with blunt tips were used. A metal bolt or nut was suspended by a short piece of string from the top of the rack to the center of the bull's eye. The blind archer, who stood at a distance of 20 or 25 feet from the target, was given a piece of string connected with the metal bolt or nuts. He would pull this string, which caused the bolt or nut to tap the center piece of steel (the bull's eye). After thus ascertaining the direction of the target by sound, he would release the snub-nosed arrow. It was possible to tell by the differences in the metallic sounds which of the different-sized pieces of steel he had hit.

Of all sports, bowling was most popular. Each week, a group of 20 or 30 men were taken to the recreation center in Phoenixville, where each patient usually bowled 2 full games. Scores ranged from zero to an alltime high of 230. Competitive matches were held between the Valley Forge General Hospital

team and teams from the Philadelphia Naval Hospital and Old Farms Convalescent Hospital.

Swimming was next to bowling in interest (fig. 21). Originally, a private pool at Malvern, Pa., was used during the summer, with groups of 10 or 15 patients going twice weekly for swimming and sunbathing. During the winter months, the YMCA pool at Norristown was used. Eventually, a swimming pool was built on the post and could be used daily.

Golf was a popular sport during the summer months (fig. 22). A few simple rules followed by the instructors made the game interesting as well as practical for blinded men, and the sport had the additional advantage of keeping them out in the open air and giving them a chance to walk around in large open spaces, with no fear of running into the obstacles found inside buildings and on the streets. The instructor would watch the student swing, then tee the ball for him, so that it would be in the path of the swing. When approach shots were made, the instructor would estimate the distance and suggest the number of the club to be used. After the ball was on the green, the patient was led from the pin to the ball to establish direction and distance. When the golfer had returned to the ball and had taken his stance for putting, another instructor would tap the pin in the cup. The tapping sound aided in establishing distance and direction. The patients were required to finish all putts.

During the summer of 1944, a golf tournament was held, participated in by about 20 competitors. It was won by a totally blind patient who had not



FIGURE 21. - Blinded patients enjoying swimming and sunbathing.

played golf as a civilian before induction. A handicap system was used. A similar tournament in 1945 was won by a partially sighted man who had played a good deal of golf before induction.

When the reconditioning program was started, 3 to 5 patients were taken weekly to the Fox Riding Academy in Port Kennedy, Pa., by arrangements with the Phoenixville branch of the American Red Cross. Later, when horses were kept on the post, six were reserved for blinded patients who rode daily.

A large private roller-skating rink, at Conshohocken, Pa., was made available by the owners, and once weekly 13 to 15 patients were taken to it by the Red Cross Motor Corps. The Red Cross furnished hostesses as partners. With a former Olympic rowing champion serving as coach, rowing was practiced



FIGURE 22.—Blinded patient playing golf.

from the Bachelors' Barge Club on the Schuylkill River in Philadelphia with 12 to 14 men rowing a 6-oar barge weekly. Two annual regattas were held with the Philadelphia Naval Hospital. All these competitive sports were not only good exercise but were most useful morale builders.

The Camp and Hospital Council of the American Red Cross provided for the purchase of five tandem bicycles (fig. 23), on which sighted instructors usually rode with the blinded men.

From 2 to 6 patients were in constant attendance at the weekly dancing classes held on the post. In addition to the recreational aspect, important lessons were learned in balance, direction, and timing. The reconditioning office of the hospital supplied fishing equipment, and fishing was indulged in in a nearby pond stocked for the special use of the patients, many of whom

found this an interesting and satisfying outdoor sport. Ten or fifteen patients in 1945 were given instruction in ice skating at the Philadelphia arena.

Patients whose multiple handicaps prevented their participation in the program of sports described were assigned instructors and guides, who took them on hikes of such length as they could tolerate. Individual exercises were prescribed by the ward officer and were administered under the direction of the reconditioning staff.



FIGURE 23.—Blinded patient exercising on tandem bicycle.

Curriculum

Braille.—The basic course in the teaching program was Braille, which was offered to every patient as soon as he was mentally and physically capable of receiving instruction. He was taught individually until he had learned the alphabet, then was taught in a group with two other students. It was expected of every patient whose stay in the hospital was of sufficient duration that before his transfer or discharge he would have learned grades 1, 1½, and 2 and would be able to read with accuracy and a fair degree of rapidity. It was expected also that he would have learned the alphabet to the extent that he could make his own personal notations and keep his essential personal records.

In 1944, blinded patients in the Valley Forge General Hospital received approximately 10,000 instruction hours in Braille by teachers who taught approximately 4,000 hours. The books used consisted of the standard Braille series in three volumes, the Braille edition of The Reader's Digest, and miscellaneous Braille periodicals. Braille slates, styluses, and writers were also used.

Typewriting. Typing was offered to every patient mentally and physically capable of accepting instruction. Teaching was by the class method, though patients whose disabilities did not permit them to attend classes were instructed individually. These were patients who had lost an arm, a hand, or fingers, or who did not have the full use of these members. Classes, which were begun periodically as new patients were admitted, were limited to 12 members at the maximum; the usual number was 6 to 8. Every patient who undertook the course was expected to learn typing to the extent of his ability. This implied that he had learned the keyboard and the mechanics of the machine sufficiently well to handle his own correspondence or to continue his training later at Old Farms Convalescent Hospital. In the majority of cases, the patients who stayed at the hospital a sufficient length of time learned to type accurately and with reasonable speed; that is, 25 to 40 words per minute.

During 1944, approximately 9,000 student hours of typing were taught by instructors in approximately 1,500 hours of teaching.

Music. Instruction in music was offered to patients who expressed a desire to learn or to continue with courses already started. Courses, which were individual and regularly scheduled, were offered in piano (fig. 24), bass violin, guitar, mandolin, banjo, accordion, saxophone, trumpet, and clarinet. The degree of achievement varied with the ability and application of the individual patient. Most of the men had had no previous instruction, and fundamentals were stressed in all instruction given them.



FIGURE 24.—A participant of the music-training program during a piano-practicing period.

Reading.—In addition to the time devoted to reading in the formal hospital program, volunteer workers came daily to the hospital and read to the patients who desired this aid. The majority of the patients were interested in novels, but some were more interested in current events, and a few desired to keep up with scientific subjects in which they had previously been interested.

Occupational Therapy

Occupational therapy was given at the bedside or in the workshop as the condition of the patient demanded. Bedside craft was offered to each newly arrived patient upon the approval of the ward officer and as quickly as he deemed it advisable. It was offered to newly arrived ambulatory patients during the periods in which they were required to remain on the ward for medical and other examinations and was always provided at the bedside for bedridden patients. Instruction, which was given 3 times a week for 45-minute periods, included the making or assembling, or both, of leather articles such as wallets, purses, electric-razor cases, comb cases, luggage tags, belts, Brailie slate cases, and record cases; weaving of luncheon sets, table runners and mats, rugs, braid, belts, and potholders; plastic molding of military insignia and other articles; and simple string work.

The bedside-craft program was a valuable morale-building method. It provided entertainment during the time patients were restricted to the ward. Most important of all, it aided in the development and improvement of manual dexterity by teaching patients to use their hands and fingers skillfully.

Occupational therapy in the workshop (fig. 25) was offered to all patients approved for this training by the ward officer. Instruction was given 3 times a week for 90-minute periods in leathercraft, rug weaving on floor looms, rug and pattern weaving on table looms, plaster molding of animals and figures, clay modeling and turning, and kiln firing.

During 1944, from 28 to 68 patients worked in the workshop each month for periods varying from 457 to 903 hours; the lower figures are for the earlier months of the program.

Placement in Private Employment

During the first year in which Valley Forge General Hospital functioned as a center for the blinded, many of the patients under treatment reached a degree of proficiency and independence which made it necessary to seek outside interests for them. An orientor who had worked with a civilian Federal agency as a job-placement officer for the blind was therefore given the assignment of investigating manufacturing plants in the neighboring towns, with a view to placing blinded patients in appropriate positions. Within a short time, there were more jobs available than there were patients to fill them. The usual plan was to place a patient tentatively in a certain position; if,

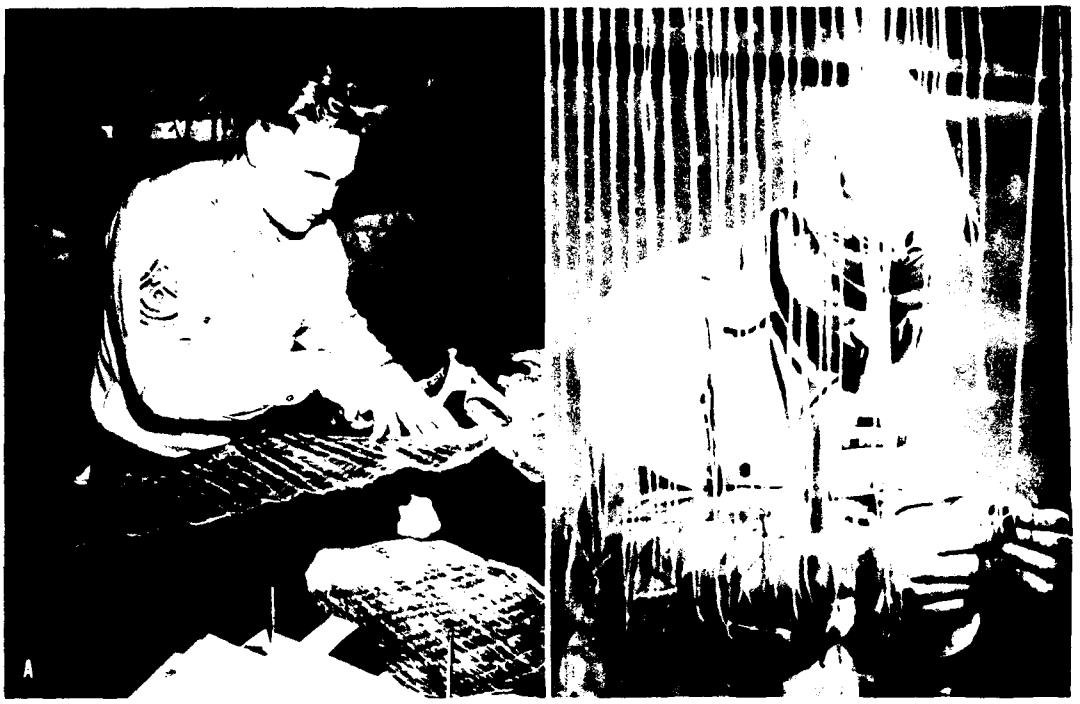


FIGURE 25. Occupational therapy in the workshop. A. Leathercraft. B. Loom weaving.

within a reasonable time, he proved that he could equal the factory production standards, he was placed on the payroll at regular wages. No patient was permitted to work more than 6 half days a week.

The policy of permitting private employment was excellent from every standpoint, particularly the standpoint of morale. When the hospital at Old Farms was opened, however, patients who had received maximum benefit from hospitalization at Valley Forge General Hospital could be transferred directly to it, and private employment at the latter hospital was gradually terminated.

Recreation and Social Service

Recreational activities included teas and other parties, suppers, dances, visits to country clubs and private homes, deep-sea fishing, swimming and roller-skating parties, and similar events. Plays, concerts, radio broadcasts, and similar forms of entertainment were included in the recreation program, which at many points overlapped the physical-reconditioning program (p. 176). The majority of these events were planned and carried out by the American Red Cross, whose objective was to supply a different type of entertainment for each night of the week. Sighted orientors or other qualified attendants accompanied the patients when they left the hospital.

The Red Cross encouraged the patients to play checkers, various card games, bingo, and other games adapted to their disability. Special attention

was directed to entertainment for patients who were unable to leave the wards. Many private homes in the vicinity were opened to the patients, and they were entertained for various meals and sometimes for weekends. At one such home, patients and their wives were invited to spend several days at a time and could make the adjustments which were sometimes difficult after a long separation and with the new handicap of the husband.

The American Red Cross served as the link between the blinded patient and his family in the guidance and adjustment program. A worker visited each new patient shortly after his admission and kept up with him thereafter. She assisted patients to plan their furlough travels, arranged all schedules, arranged for Travelers Aid workers to meet the patients if changes of trains were necessary, and verified the fact that each patient would be met at his destination by his family. Special services were given as needed.

Hobby shop.—The hobby shop, which was what its name implies, played an interesting and useful part in the rehabilitation of the blinded who cared to use it. During 1945, the monthly attendance ranged from a low of 65 in December, when monthly admissions were beginning to decrease, to a high of 103 in July and 101 in October. The hours of use varied from 720 in January to 1,204 in October. The shop was also used for more than a thousand hours during the months of July, August, September, and November.

Family Relationships

The family relationships of the blinded casualty were recognized early in the war as being of major importance. In line with this recognition, Brig. Gen. (later Maj. Gen.) Paul R. Hawley, Chief Surgeon, European Theater of Operations, himself wrote to the mother of the first soldier who was blinded in that theater (appendix C, p. 561).

When the necessity arose for communication with the families of blinded casualties in the Zone of Interior, it was thought that General Hawley's letter so adequately met the situation that it was routinely enclosed with the letter (appendix C, p. 562) which notified the family that the patient had been received at a special eye center for treatment.

Different letters were addressed, respectively, to the family of a soldier with some remaining vision (appendix C, p. 562) and to the family of a hopelessly blinded casualty (appendix C, p. 563).

Members of their families were encouraged to visit the blinded soldiers at the hospital. They met the ward officer or the chief of the service, and the patient's condition and progress were discussed with them frankly. The part which the family might play in his future was also gone into in detail, and it was emphasized that the man must be treated as a normal human being. Great stress was put upon the fact that he must be allowed to do for himself whatever he could. This paved the way for the first reunion with the soldier and made adjustment less difficult for all concerned.

If the family could not visit the soldier promptly, the nearest of kin, as first noted, received a letter from the chief of service, enclosing the letter which General Hawley had written to the parents of the first soldier blinded in the European Theater of Operations.

EMOTIONAL ADJUSTMENT OF THE BLINDED CASUALTY

Part of the program for the blinded at the Valley Forge and Dibble (Letterman) General Hospital Eye Centers was thorough psychiatric examination shortly after admission and again before the soldier's transfer to the special rehabilitation installation at Avon, Conn. A detailed psychiatric study was also made of the man's civilian and military adjustment. These examinations were a routine part of the program for the blinded and were not predicated on the presence or absence of indications for psychiatric investigation.

It was promptly learned at the special eye centers that the best plan of approach to the blinded casualty was to evaluate at once the status of the eyes and the chances of recovery of useful vision, then to tell the patient frankly and honestly what the outlook was. Generally speaking, the man of sound personality, without preexisting neurotic or psychiatric traits, was likely to receive the information courageously, accept the disability with fortitude, and throw himself earnestly into the program for his rehabilitation. It was also found to be generally true that totally blinded soldiers were likely to make more rapid adjustments to their handicaps than men who retained slight vision or merely light perception, for the reason that casualties in the latter groups built up false and futile hopes of recovery of good vision.

Analysis of Cases

In a study of the emotional adjustment of 150 blinded casualties observed at Dibble General Hospital during World War II, Diamond and Ross [25] found that 134 had been injured in combat and 16 had lost their sight as the result of disease or of non-combat-connected injuries. One to three months had elapsed between the loss of sight and the inauguration of the psychiatric investigation. Of the 150 blinded casualties, 81 had no vision in either eye; 43 had light or movement perception in one or both eyes; and 26 had vision varying from 20/1000 to 20/200 in the better eye. Blindness was the dominant problem in the majority, though a few patients also had amputations or orthopedic disabilities. Most of the patients blinded in combat also had associated facial or other injuries of varying degrees, ranging from minor head and facial lacerations to destruction of parts of the face and jaws, multiple fractures and amputations. Eleven patients showed evidence of fairly severe trauma to the brain.

[25] Diamond, B. L., and Ross, A.: Emotional Adjustment of Newly Blinded Soldiers. Am. J. Psychiat. 102: 367–371, November 1945.

Of the 150 blinded casualties studied, 89, approximately 6 of every 10, were regarded as well adjusted to their blindness. They had accepted the visual disability on a realistic level, without attempt to deny, hide, or obscure its implications or to take refuge in fantasy directed toward miraculous cures. They were wholeheartedly endeavoring to reconstruct their lives on a socially useful foundation and to reestablish their socioeconomic independence. They were entirely free from any evidence of emotional depression, anxiety, fear, functional symptoms, or social misbehavior.

Psychiatric factors seriously interfering with adjustment were found in 27 (fewer than 2 in every 10) of the 150 blinded soldiers studied. Thirty-four others (slightly more than 2 in every 10) showed slight or borderline evidence of emotional disturbance. The patients in the latter group presented symptoms of such a minimal character that they would not have been reclassified or otherwise restricted in their military duties for these symptoms alone. The most frequent symptoms presented by maladjusted soldiers were, in the order of occurrence, anxiety and hysterical symptoms, mood disturbances, undesirable aggressive behavior and attitudes, excessive dependency and apathy, unrealistic attitudes, obsessive guilt reactions, and mental confusion with memory difficulty.

The background history of the 150 casualties revealed significant social or neurotic traits in 32, 15 of whom developed definite evidence of maladjustment to their blindness and 11 mild or borderline symptoms; the other 6 achieved adequate adjustment. Patients with previous neurotic tendencies showed marked tendencies toward excessively dependent attitudes and resisted efforts to stimulate an interest in their rehabilitation. They apparently lacked any significant motivation to help themselves. Some accepted their blindness with a smug, self-contented attitude usually associated with a conversion hysteria, thus indicating that their blindness had at last achieved what they had always wished for; that is, complete passive dependency. Casualties with aggressive or other psychopathic traits in their background consistently adopted aggressive, resentful attitudes toward their blindness. Emotional depressions, outbursts of temper, alcoholism, and similar behavior were common in this group. On the other hand, their aggressions were controllable, and eventually they seemed to adjust better than the neurotic group.

Blindness not of combat origin or blindness resulting from disease was often associated with emotional depression, guilt reactions, and aggressive behavior. A soldier in this group was likely to feel that his blindness was needless and could have been avoided. Bitter hostility directed both outwardly and against himself was frequent. Remorse and rumination over the man's own responsibility for his condition, whether real or imaginary, were observed in some instances. This attitude is readily explained. Blindness is always a powerful blow to one's ego. In combat-incurred cases, support to the deflated ego was gained by the realization that the soldier had done his part for a worthy cause. The non-combat-blinded soldier had no such support. It

therefore seems significant that of the 16 men with non-combat-connected blindness, 10 were maladjusted, and 4 of the 10 were in the borderline group.

Organic pathologic change in the brain did not seem a factor of great importance in adjustment. Five of the eleven patients with clear-cut evidence of brain damage were markedly disturbed; four showed mild symptoms, including headaches and memory difficulties; and two adjusted well to their visual disability.

In a small number of patients, anxiety symptoms developed and, occasionally, depressive reactions in response to poor attitudes on the part of wives or other relatives. Ordinarily, these problems were easily adjusted. Occasionally, however, a wife would be overprotective, insisting on guiding the patient about, looking after his needs, and in similar ways preventing his learning the basic needs of self-orientation.

This group of blinded casualties proved, as has been mentioned, that more difficulties arise in adjusting to incomplete than to complete blindness, even if there are neurotic or psychopathic factors in the background. In the partially blinded group, false hopes and anxieties gave rise to depression, aggressive behavior, or frank neurotic symptoms and often seriously interfered with the program of rehabilitation. Of the totally blinded soldiers, 15 percent were definitely maladjusted mentally, against 26 percent of those with light or movement perception. When vision was 20/1000 or better in one or both eyes, however, only 11 percent of the patients had symptoms of maladjustment, all of the borderline type. The explanation apparently is that persons with sight of this degree can utilize it to good advantage in taking care of themselves, whereas those with only light or movement perception obtain very little actual benefit or use of such sight as they have; their minimal visual function seems to serve only as a confusing sensory handicap.

It cannot be overemphasized that giving false hopes and casual reassurances to blinded men is as foolish as it is cruel. Without exception, those patients who had been so reassured stated that the false information made everything infinitely harder for them and succeeded only in dragging out and perpetuating their original psychic trauma. Lack of accurate information concerning the status of their sight and the possibilities for the future repeatedly served as a definite element in provoking anxiety reactions among these blinded men. It was repeatedly observed, on the other hand, that incapacitating anxiety symptoms could be alleviated by frankly discussing with the patient his disability and his future prospects. These soldiers wanted the truth and wanted it at once. A postponement of the explanation of the disability and its outcome merely prolonged doubt, insecurity, and anxiety and was attended with the risk that thoughts, feelings, and actions might be so crystallized as seriously to interfere with social and economic rehabilitation.

Most of the maladjusted casualties among these 150 blinded patients were treated by readjusting the rehabilitation program to fit their particular needs. A passive, too dependent man received special encouragement. An

aggressive patient often required some letup in the program, with the opportunity to vent his hostility in the safe confines of the psychiatrist's office. Direct psychotherapy was given to a number of depressed and anxious patients. Unrealistic attitudes were corrected. Often, the psychiatrist determined when and how the patient should be informed of his disability and his future prospects.

In general, therapeutic results from the standpoint of psychiatry were determined by the amount of predisposition. On the other hand, in some instances of most unpromising backgrounds, a satisfactory compromise adjustment was possible.

PROGRAM AT OLD FARMS CONVALESCENT HOSPITAL (SPECIAL)[26]

With the passage of time, it became increasingly clear that the program for the rehabilitation of the blind, as originally planned, was not adequate and that it must be the responsibility of the Army to fill the gap present between the discharge of the blinded man from a special eye center and the assumption of his vocational training by the Veterans' Administration. Essentially, this was a matter of social adjustment. With the recognition of this obligation, the necessity for the establishment of some central institution to provide the necessary training became obvious.

The original plans of the President's Committee on Rehabilitative Measures with respect to blinded servicemen[27] directed that both Army and Navy casualties be trained in social adjustment in the same installation. The Navy, however, thought that it would not be satisfactory to Army or Navy personnel to be trained together and therefore continued its own program. In retrospect, it is evident that the duplication of training, personnel, and facilities resulted in a waste of time, money, manpower, and effort which might usefully have been devoted to other purposes.

It was clearly recognized, by all connected with the program of rehabilitation for the blind, that certain tempting pitfalls must be avoided, such as the following:

1. Making life too easy for the blinded casualty. To have done so would have been to follow a line of least resistance which would have simplified the whole problem but which would have been indicated only for reasons of sentiment.

2. Keeping the patient in a hospital. This would have been disastrous for his morale and for any hope of future rehabilitation.

3. Discharging the patient and letting him take his chances with some of the civilian institutions for the blind. Apart from the fact that the civilian

[26] (1) Report on Old Farms Convalescent Hospital (Sp), a Social Adjustment Training Center for Blinded Service Personnel, by Col. Frederic H. Thorne, MC, 21 June 1945. (2) Memorandum, Maj. M. E. Randolph, MC, for The Surgeon General, 11 Nov. 1944, subject: Report of Trip of Maj. M. E. Randolph, MC, to Old Farms Convalescent Hospital (Sp), Avon, Conn., 6–8 November 1944.

[27] See footnote 17, p. 160.

institutions were of varying degrees of excellence, which would have meant a lack in uniformity of training, they could not possibly have taken over a problem of such magnitude.

4. Making the planned institution a combined hospital and training school. A plan of this kind would inevitably have resulted in defeat of the objective of the program; that is, social adjustment.

Selection of Site

With the decision to establish, equip, and operate a social-adjustment training center for blinded service personnel, a search was undertaken for a suitable location, preferably near a large city, where outside entertainment and contacts would be plentiful and where an abundance of industry would make tryout jobs suitable for the blind readily available. In all, some forty sites between Massachusetts and Colorado and as far south as Florida were investigated, but none proved satisfactory. One otherwise desirable building was too small, another was not fireproof, and others failed to meet the specifications in various ways. The most suitable building found could not be secured because State laws prohibited its use for the housing of blinded persons.

Eventually, in April 1944, a site which seemed to meet necessary requirements was found in a private school for boys, Old Farms, near Avon, Conn. This school, which was closing its doors 2 June 1944, for the duration of the war, was leased, with the furniture and equipment, for the duration of the emergency plus 6 months. The hospital was authorized as Old Farms Convalescent Hospital, Special, (fig. 26), 21 May 1944, and was activated 14 June 1944, with Col. Frederic H. Thorne, MC, commanding.

The Corps of Engineers from Bradley Field was responsible for the conversion of the building to its new purposes. Their work included window screening, the installation of screen doors, a new sewage-disposal plant, greenhouse, chickenhouse, five additional wells an automatic sprinkling system in the dormitories, and antimosquito and pest-control measures.

Equipment

Standard quartermaster and medical supplies were easily procured when Old Farms Convalescent Hospital was activated, but the specialized equipment needed to operate the school shops and classrooms for the blinded was difficult to procure and its delivery was long delayed. The initial shop equipment, such as drill presses, milling machines, and woodworking power machinery, was borrowed from local industry and from the National Youth Administration, which made it possible to get shopwork under way long before Government equipment was secured.

The furniture of the Avon Old Farms School, which had been taken over with the building, proved entirely unsuited to the purposes of the hospital and



Fig. 1. — Old Farms Convalescent Hospital.

eventually had to be removed to temporary warehouses erected for storage purposes.

Personnel

When Old Farms Convalescent Hospital was activated in June 1944, the military personnel consisted of the commanding officer, a chief warrant officer, and an enlisted man. Three nurses and fifty one enlisted men, most of whom had had no previous experience with the blind, had been placed on temporary duty at Valley Forge General Hospital and had been given intensive training in this field while waiting for the activation of the new hospital. The majority of the enlisted men were transferred to the Old Farms Hospital during June. One of them, who had had a long experience with the blind in civilian life, was made director of training and was later commissioned. Another experienced placement officer, who had worked as orientor at Valley Forge General Hospital for a year, was also transferred to the new hospital.

On 2 June 1944, the hospital was given a temporary allotment of 9 officers, 3 nurses, 1 physical-therapy aide, 1 dietitian, and 92 enlisted men. The assignment of nurses was completed in July, as was the assignment of the dietitian and the physical-therapy aide. The assignment of officers was completed in August and the assignment of enlisted men in October. Effective 31 May 1945, the allotment of military personnel was changed to 9 officers, 2 nurses, 1 dietitian, 1 chief warrant officer, and 140 enlisted men. At all times, more than half of the enlisted personnel were assigned to duty as instructors. Few of them had had previous experience in work with the blind, but they responded quickly to training and became extremely proficient.

The original allotment of civilian personnel for Old Farms Convalescent Hospital was 100. Procurement of clerical help was not difficult, but procurement of civilian instructors was extremely difficult, as most experienced workers were already holding positions in civilian organizations or in other Army hospitals. The first civilian employee secured was experienced in civilian personnel administration. She was at once given control of all civil-service employees, the number of whom at one time was 71. The first three civilian instructors, who arrived in July, were all blinded. One, an instructor in Braille, proved entirely satisfactory. The others, who taught agriculture and woodworking, respectively, did not prove satisfactory. It was found that the ability of totally blinded persons to teach in such a school as was conducted at the Old Farms Convalescent Hospital was extremely limited, while partially sighted but industrially blind instructors proved *quite adequate*. The number of civilian instructors eventually reached 25. In May 1945, the allotment of civilian employees was raised to 150. The end of hostilities, however, made it unnecessary to engage the additional number authorized.

The most difficult factor in the administration of Old Farms Convalescent Hospital was the constant turnover in personnel. In September 1945, limitation on the hiring of civilian personnel, which actually required the discharge of some of the staff, coincided with the period during which intake was reaching its peak. The personnel situation was further complicated, a little later, when demobilization brought about a sudden drop in enlisted personnel. The loss was particularly felt in the orientation course, which was the most important single course the blinded casualty was given. By the end of 1945, in fact, it had ceased to be taught as a standard course, chiefly because of the gradual shift from thoroughly trained enlisted personnel to less well trained civilian personnel.

Medical Activities

Medical activities at Old Farms Convalescent Hospital were provided for in a 10-bed dispensary. One medical officer, three nurses, and a physical-therapy aide were originally assigned to the station, but it was found that the physical-therapy aide was not needed and that one nurse could handle all the work.

All acutely ill patients were at once transferred to the hospital at Bradley Field, 20 miles away, from which those who required additional treatment were transferred to appropriate installations. Vocational and social interpretations, as well as appraisal of physical handicaps, were made with the cooperation of the post surgeon, who obtained psychiatric consultations if he considered them necessary after unusual or abnormal behavior had been reported to him.

In addition to these duties, the post surgeon served as medical inspector, safety officer, and venereal-disease-control officer.

Training Division

With the activation of Old Farms Convalescent Hospital, the director of training, who at that time did not have commissioned rank, was obliged to begin his activities with the training of instructors, orientors, escorts, dormitory personnel, and others in the handling and care of the blind, in which few of them had had any experience. To expedite this training program, the director of training himself assumed the responsibility for housing, supplies, and other administrative details. Training in general followed the plan already outlined for Valley Forge General Hospital (p. 164).

It was emphasized to orientors that the primary duty of the instructor was to teach the patient to get about by himself in a familiar environment and to teach him a system for finding his way about in an unfamiliar environment with the minimum of aid. It was also emphasized that all instructors must teach by a uniform technique.

The second duty of orientors concerned the patient's "personal organization," this being a term used to cover every phase of his routine activity not covered by such isolated skills as Braille, typing, travel, and the like. All instructors were given 2 weeks of rigorous instruction, part of it blindfolded, including travel, 30 hours; special methods, 12 hours; demonstrations, 12 hours; sports, 12 hours; background lectures, 12 hours; discussion, 10 hours; detail and detachment duty, 6 hours; and tests, 2 hours.

Soldiers proved particularly adapted to service as orientors. Military life had taught them the value of alliance as opposed to domination, from which the patient would naturally have recoiled. Orientors were not expected to be psychologists but merely to use initiative and commonsense. The background of their every act was expected to be predicated on the fact that a blind man is simply a man who cannot see and that otherwise he is a normal human being.

Counseling was found to be an activity second in importance only to orientation. At the height of its activity, the Old Farms Convalescent Hospital had a supervisor of counselors and six other counselors, among whom the caseload was divided. A staff sergeant and two assistants worked with the counselors in checking absences from classes.

The individual counselor served as a sort of manager for the casualty assigned to his care, as well as his friend and guide. He was of great influence

in shaping the blind man's program, stimulating him, and planning, with the officials of the Veterans' Administration, his course after he left the hospital. The consultant in psychology and the psychometric division, which at the height of activity had five members, worked closely with the counselors.

Training council. The training council proved to be the most useful and valuable administrative training unit at the school. It was composed of the director of training, the consultant psychologist, the post surgeon, the chief occupational therapist, the director of Red Cross activities, the Veterans' Administration representatives, and all the counselors. The council met daily. At this time, the special problems of individual men were discussed and appropriate action taken. As a result, no decision was made without careful general consideration, and no problem was likely to be overlooked. The training council was established early in the history of Old Farms Convalescent Hospital and proved to be the chief factor in the integration of the program as it directly affected the individual casualty.

The first blinded patient was admitted to Old Farms Convalescent Hospital 14 July 1944. He was particularly chosen to be the first because he was well oriented and was to be used as a guinea pig to detect pitfalls in the physical setup, such as corners to be avoided, low doorways to be remembered, and similar undesirable conditions which, if they could not be corrected, could be pointed out to patients who were not oriented. It was possible, however, to make numerous corrections before the first group of blinded men arrived.

Characteristics of Trainees

The essential criterion for the admission of blinded casualties to Old Farms Convalescent Hospital was that they should have reached their maximum therapeutic and physical rehabilitation in one or the other of the eye centers. The new hospital was to be a school, not a hospital, though medical, particularly ophthalmologic, care would be available if the need arose.

All the patients presented certain group characteristics which gave a uniform quality to their social adjustment. All were relatively young men; all were soldiers who had shared numerous experiences in common; all were physically fit and active when they became blind; and all were newly blinded.

Otherwise, individual physical and mental differences were marked. Social differences were equally marked. The students presented a mental range from feeblemindedness to education on the doctor of philosophy level. The age range was from 19 to 38 years. Physical handicaps ranged from nothing more than restricted fields of vision, with ability to read typewriting to total blindness in a hard-of-hearing man who had lost all digits on both hands except one thumb. In rank, the range was from private to lieutenant colonel. One man lived in Honolulu; another had lived for many years only a few miles from the hospital. Some men had been blinded through their

own carelessness, but one had received the Distinguished Service Cross for heroism under fire.

As a result of this wide range of training and intelligence, group teaching was not practical. The program had to be flexible, and the approach to each man had to be on the individual basis.

Social-Adjustment Program

The general objective of the social-adjustment program at Old Farms Convalescent Hospital was to prepare the student for homegoing, equipped with a sensible plan for employment or continued training, possessed of a knowledge of his own interests and abilities, ready to lead a useful and enjoyable life and to fit with self-reliance into his community.

The methods used in achieving these results were general activity, tryout, orientation, and guidance, rather than prolonged instruction in special skills. The patient's cooperation was secured by the friendly attitude of the staff and by stimulation of his special interests. The creation of a modified military or semicivilian environment while the student was still in the Army endeavored to duplicate for him types of problems and situations he would meet upon discharge and thus to anticipate social difficulties and demonstrate approaches to their solutions. By individual and group instruction, he was trained in basic skills such as typewriting and Braille (fig. 27). He was taught the art of getting around alone and with people. He was provided with experience in a range of prevocational training classes. By trying out a variety of activi-

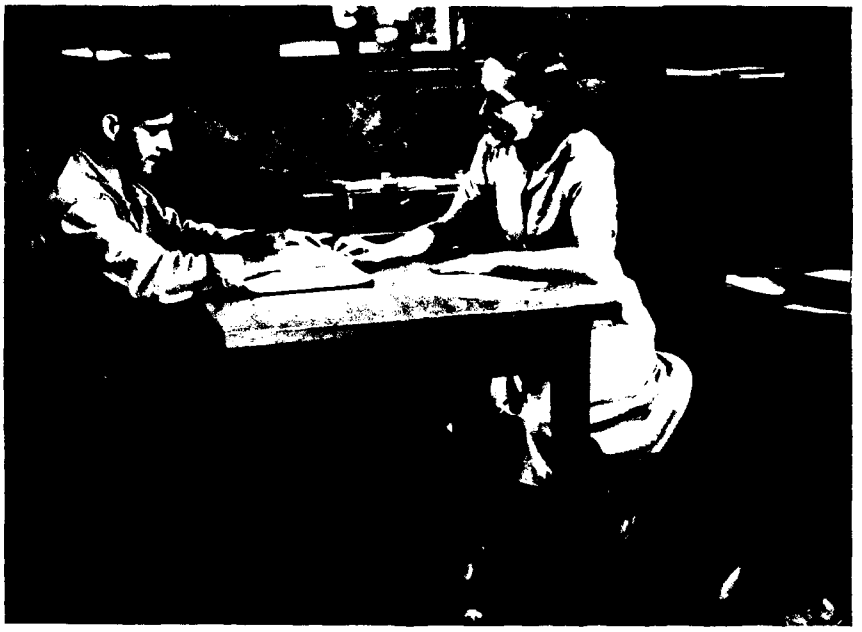


FIGURE 27. Blinded patient receiving Braille instruction from blind teacher.

ties both at school and nearby communities, the student's former interests were confirmed, new ones were sought out, and aptitudes were put to the test of actual performance. His personality was appraised by continuous interviews and with the aid of psychologic measures. Finally, counseling developed self-guidance and led the student to the formulation of immediate and long-range plans for his civilian career.

The first group of blinded men to enter Old Farms Convalescent Hospital consisted of eight casualties all of whom had been blind from 12 to 18 months. They had long since completed their preliminary hospital training. They were irritable and belligerent to all things military. Their primary desire was to be separated from the service in the shortest possible time. They were not in the least interested in social-adjustment training. In spite of these adverse beginnings, most of the men remained for the full 18 weeks of training and made an excellent adjustment to their handicap.

In September 1945, a survey of the school [28] showed that, although attendance at all courses was entirely voluntary, as a rule 80 to 90 percent of the enrolled membership was present regularly at all assignments, including athletic and sports events. The latter were less well attended than other classes, and, if they were excluded, the course attendance was more than 90 percent.

The survey also revealed that 80 percent of the population at the hospital from the beginning of its operation were classified as satisfactorily adjusted and doing good work. It was interesting to learn that 95 percent of the students came to the school against their will but that, after beginning the scheduled courses, not more than 20 to 25 percent would have left had the opportunity presented itself.

These various figures might be compared with an estimate made by Dr. Alan C. Woods at a meeting of the Subcommittee on Ophthalmology, National Research Council, held 4 January 1944. At that meeting, Dr. Woods stated that, on the basis of experience at the Evergreen School after World War I, blinded men capable of rehabilitation might be divided into four groups. The men in the first group needed little rehabilitation. Those in the second group needed rehabilitation and were able to take advantage of it. The third group consisted of permanent hospital patients with other injuries, such as brain injuries. The fourth group consisted of men who would finish the courses in rehabilitation but who would always need institutional protection. They would never be able to care for themselves, and it would be best for them to to work in some supervised place. The fourth group comprised 20 to 25 percent of all blinded casualties who undertook rehabilitation.

Discipline.—Discipline was never a serious problem at the Old Farms Convalescent Hospital because careful plans had been made to prevent its becoming one.[29] In general, these plans took the following directions:

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[28] Memorandum, Maj. Trygve Gundersen, MC, chief consultant in ophthalmology, for The Surgeon General, 28 Sept. 1945, subject: Report on the Army Blind Program.

[29] Prepared by Pvt. A. R. Blackburn, Jr., June 1944, then director of training.

1. It was realized that these blinded men had finished with the Army and that some of them had built up a resentment against it. Even if they had not, they were anxious to be separated from it. The military aspect of the school was therefore subordinated, as far as possible, and the major emphasis was put on a prompt return to civilian life. On the other hand, it was impressed upon the students that they were still in the Army and that the Army would be judged by their demeanor and conduct when they left the hospital grounds for recreational or other purposes.

2. The program was conducted with an element of urgency. It was the objective to get the man through it as promptly as possible, but this was not considered to be achieved until he had completed his training and knew what he proposed to do. It was emphasized that certain tests, which denoted levels of proficiency, must be passed before the student could be discharged by Certificate of Disability, and this necessity had a direct bearing on problems of discipline; men striving to achieve certain goals did not have much time left to get into mischief. On the other hand, standards were reasonable, and no man was asked to do more than his intelligence, previous training, and education fitted him to do.

3. Attendance at all courses was voluntary, but it was nonetheless strictly checked and absences were promptly reported to the central office. The absentee was at once interviewed, and every effort was made to find out why a man in attendance at a training school would not attend classes. A certain number of absences without excuse could be overlooked. Too many, however, would have affected the morale of other students, and the willful violator was given a furlough, which delayed his discharge from the school. Then, if his absences continued, he was given a Certificate of Disability discharge. It was made clear to him, before this penalty was invoked, that his record was passed on to the Veterans' Administration and would definitely influence his chances for a good job.

4. Many difficulties were avoided by careful planning of schedule and courses so that few deviations were necessary, for the blind are inclined to resent change. Detailed explanations concerning the intention of the whole course and of special courses were given during the student's first days at the school. The regulations, which were kept as simple as possible, were announced and explained. No promises were ever made about the time of discharge or about anything else. It was made clear that the man's progress to discharge would depend upon his own achievement.

5. Kindness and consideration dominated the whole program, though there was no coddling. There was, however, uniform firmness, with a clear understanding of what was and was not permitted and also a clear understanding that there would be penalties for the infraction of rules.

6. Weekend passes were not encouraged. The planned course was brief, and it was believed that the fewer distractions, the better. One day passes were given generously on Saturdays and on Sundays, and men who did not

go out on passes were encouraged to spend Sundays in outdoor recreation and social activities. Men were not encouraged to bring their wives into the neighborhood. Housing facilities were poor, and it was believed that the presence of wives was distracting.

7. Every effort was made to break down the philosophy that a pension solved a blinded man's problems. Appeals to his pride, the argument that a pension of $175 a month will not support a family and buy many luxuries, and discussion about the pernicious effects of idleness were all used to convince the soldier that he would be better off with useful and productive occupation.

8. The attitude of the teaching and guidance staff toward their blinded pupils could be expressed about as follows: At this phase of your life, we know better what is good for you than you do yourselves. You are young and inexperienced, as well as blind. Now you need sound advice in a good many matters; later, you may exercise your individual judgment. This program has been built up to help you, but you must help yourself take advantage of it. We are trying to teach you self-reliance, but we expect you to obey certain rules. If you cannot abide by the simple discipline of this school, you will never measure up to the harsher discipline of the outside world. In it, fewer and fewer concessions will be made as your family and friends become used to your blindness. People help the blind who help themselves. Therefore, we shall not coddle you, and you will be punished for infraction of regulations exactly as if you were sighted. The man who works hard and keeps the rules will be out of here in a minimum period. We shall do everything we can to help you achieve this purpose.

Thanks to this clear understanding of what was expected of the patients and to the strict enforcement of a few simple rules, discipline presented no problems of consequence at the Old Farms Convalescent Hospital during the first months of its operation. A subtle change took place, however, after the cessation of hostilities in the Pacific. The men became noticeably restless and made it clear that they wished to be discharged along with the others who were being demobilized. This period did not last long, and by the end of 1945 discipline was again as admirable as it had been.

In all, only a small group of men, not more than 5 percent of the total population, accounted for all the serious infractions of regulations which occurred at Old Farms Convalescent Hospital. These disturbances chiefly took the form of drinking and disorderly conduct. They were isolated occurrences, which could scarcely have been prevented.

It was thought that one reason for the generally good behavior of the men was the assembly meeting held at 0830 each morning and conducted personally by the director of training. Here, complaints could be made, "gripes" aired, and undercurrents of discontent as well as undesirable attitudes detected before harmful situations were created.

Acceleration of Program

The President's Committee on Rehabilitative Measures, in its report dated 8 January 1944,[30] had set 4 months as the maximum period for social-adjustment training in most cases, while granting that the length of the period would depend upon individual factors. The length of the standard course at Old Farms Convalescent Hospital was 17½ weeks, including 1½ weeks of preliminary orientation to school life. Accelerated courses of 13 weeks were planned for students of superior talents and advanced social adjustment, and an extended course of 22 weeks was planned for students who had acceptable reasons for prolongation of training.

The 16-week teaching period (exclusive of the 1½-week orientation period) was divided into four 4-week periods. Most of the courses were 4 weeks, though a few occupied 8 weeks. Courses began at 0900, following a general assembly at 0830. Each class occupied 45 minutes; 15 minutes were allowed for the changing of classes. There were 3 classes in the morning and 3 in the afternoon, except on Wednesday and Saturday, when only morning classes were held.

Orientation, physical reconditioning, and testing were required for all students. Other courses were elective, but a full schedule was required.

The original contemplated capacity of Old Farms Convalescent Hospital was 200 beds. This was irrevocably reduced to 128 when the third floor of the building was condemned as a fire hazard by the inspectors of the First Service Command. By the end of September 1945, the hospital was caring for 147 patients, 19 of whom, with their wives and families, were living in nearby private billets. At this time, Valley Forge General Hospital had a backlog of 54 blinded men ready to send to Old Farms, and Dibble General Hospital had a backlog of more that 20. In addition, the former hospital had 133 blinded men and the latter 70, all of whom were being prepared for training at Old Farms Convalescent Hospital, which, at the best, would be prepared to accept only 124 men by the first of the year if the present, approximately 18-week, teaching schedule were to be continued.[31]

The following decisions were reached at a meeting held at Old Farms Convalescent Hospital 21 September 1945, attended by the commanding officer, Old Farms Convalescent Hospital; the chief of the eye service, Valley Forge General Hospital; the chief consultant in ophthalmology, Office of the Surgeon General; the director of training, Old Farms Convalescent Hospital; and other key personnel from both installations.

1. Each potential candidate for social-adjustment training at Old Farms Convalescent Hospital would be reviewed by a board and given a certain number of weeks' credit, in no instance to exceed 12 weeks, for training undergone at Valley Forge and Dibble General Hospitals in orientation, typing,

[30] See footnote 17, p. 160.
[31] See footnote 28, p. 195.

Braille, and occupational therapy. When he reached the special convalescent hospital, he would be given additional training, to bring his total credits to the required 18 weeks. If he desired further training, it would be understood that he would be permitted to return at a later date as a veteran; for the time being, however, when the 18-week period had been met, he would be separated from service on a Certificate of Disability discharge.

2. Each blinded casualty then at the Old Farms Hospital would be reviewed and would be asked whether he desired to receive credit for work done at either of the eye centers. If he did, he would be discharged on Certificate of Disability when his credits totaled 18 weeks.

3. Patients in the borderline blind category at Valley Forge and Dibble General Hospitals would be reviewed, and those who were properly adjusted and who had definite jobs waiting for them would be brought to the attention of the Office of the Surgeon General, with the request that they be discharged from these hospitals without passing through Old Farms Convalescent Hospital.

It was thought that by means of this accelerated program and the resulting material decrease in the time each casualty would spend at Old Farms Convalescent Hospital, the blinded soldiers then in the Army could complete their social rehabilitation by July 1946.

This plan was put into effect as an expedient and served the immediate purposes for which it was intended. It was found, however, that the granting of credits for training at the general hospitals definitely depreciated respect for the program at Old Farms Convalescent Hospital. Toward the end of 1945, therefore, an effort was made to restore the full 18-week course at this hospital, and only those casualties who possessed either exceptional ability or considerable residual vision were put on the accelerated program. It was interesting to observe that toward the end of the year there was a definite trend among the men themselves to reject credits and to request the full 18-week course or, in some instances, a longer course.

Special Phases of the Training Program

The social-adjustment program was carried out in the following separate phases:

1. Orientation. This course was one of the most important phases of the work. It included orientation to the grounds, personal orientation, traveling with a cane in residential districts and in dense traffic, and training in facial vision.

2. Physical reconditioning. This course included such sports as swimming, horseback riding, rowing, fishing, bicycling, hiking, and gymnastics. It was designed to keep the student fit and to demonstrate to him what activities he could pursue at home.

3. Testing clinic. Verbal tests were given in learning ability and interests. Personality and manipulation tests were given to secure data on mechanical

and manual aptitudes. Special tests were also administered in Braille, typing, and personal orientation.

4. Guidance counseling, and profiling. An extensive course in general guidance was given to all students. Psychologic consultation was provided by the staff psychologists. A preliminary statement was made after 21 days to determine the direction of social-adjustment training.

5. Basic skills. This course included training in typewriting, Braille, Braille devices, handwriting, talking books, memory and study methods, and the use of readers.

6. Academic and professional field. This course was an introduction to methods employed by the blind for the study of English, mathematics, history, and other subjects in anticipation of a return to school. Courses were also offered in physical therapy, insurance, and salesmanship.

7. Music. This course included instruction in voice and instrumental music, theory and harmony, and music appreciation. All were taught with avocational emphasis.

8. Manual and mechanical skills. This was a group of courses designed to give adequate training for entry into factory work when training was completed or to lay the basis for a continuation of training in mechanical occupations (fig. 28). The courses included preliminary and advanced work in the hobby shop, as an introduction to manual work, woodworking, industrial skills (hand assembly and power machines), garage service, and work in printing



FIGURE 28. Training for mechanical occupations.

shops. All of these courses lead to jobs in which the blind are known to be successful.

9. Business. Under this heading, courses were given in retail business and business skills, including business methods, business arithmetic, business English, and office management. These courses were designed to prepare the students to undertake the operation of concession stands and small businesses or to provide a basis for further business training. A course entitled "Small Businesses" pointed out to the student the hazards and opportunities in this field, one in which blind are known to succeed. Actual opportunities were provided to operate stands and sell, as well as to get office experience (fig. 29).



FIGURE 29.—Blinded operator of stand serving blinded customer.

10. Agriculture. Courses in poultry raising, animal husbandry, pet stock, general farming, and greenhouse work familiarized students with techniques of farming without sight or with low vision. Actual experience was provided on farms in the vicinity of the school (fig. 30). The courses served as a basis for further agricultural training.

11. Temporary placement. Actual job experience was provided for 4 weeks or longer in industries or other selected occupations, to furnish proof to the student of his ability to succeed in competitive employment and to orient him to working with people in factories and under realistic conditions.

12. Recreation. Directed recreation supplied by the American Red Cross, including dancing, games, and attendance at social events, provided experience in social contact as well as in recreation.

Specific courses from which selections might be were made as follows:

1. Basic skills: Braille, cooking, handwriting, courses in how to study, typewriting, with advanced work at the Hartford High School.

2. Professional-academic: Business arithmetic, mental arithmetic, newspaper, psychology, physical therapy, public speaking, speech correction, reading (for pleasure and study), spelling, vocabulary, bookkeeping, creative writing, current events, directed study, business English, English composition, English literature, insurance, journalism, letterwriting, mathematics.

3. Business: Business methods, retail business, salesmanship, small business.



FIGURE 30.—Agricultural training.

4. Agriculture: Commercial poultry, farm placement, gardening, greenhouse, hobby poultry, livestock farming, pet stock.

5. Music: Accordion, cello, clarinet, drums, guitar, piano, saxophone, trombone, trumpet, ukelele, violin, listening to records, music appreciation, voice. Advanced music courses could be taken at the Hartford School of Music.

6. Industrial and crafts: Bookbinding, garage service, hobby-shop training (preliminary and advanced), hand and machine industrial skills, machine shop (including advanced work at Hartford High School), piano tuning, printing,

sculpturing and craftwork, service station, woodworking, upholstering, household appliances.

7. Field apprenticeship: Farming, poultry raising, animal husbandry, industrial, insurance, retail business, trucking, oil, giftshop, garage, tailorshop, schoolteaching, repairshop.

8. Sports: Bowling, fishing, golfing, horseback riding, ice skating, skiing, snowshoeing, swimming, tobogganing.

Criteria in the Evaluation of Social Adjustment

At the Old Farms Convalescent Hospital for the blinded, criteria used in the evaluation of social adjustment were as follows:[32] (1) Ability to orient well; (2) determination to accept a minimum of assistance; (3) eagerness for social and vocational activity; (4) control of unwholesome antisocial habits; (5) insight into limitations and potentialities; (6) genuine self-confidence in capabilities and self-assurance in ability to hold down a job; (7) ability to get along with others in the community.

Ratings according to these criteria were superior, excellent, very satisfactory, satisfactory, unsatisfactory, unadjustable, and incorrigible. The rating of unsatisfactory was given when it was thought that the man did not quite measure up to standards and could not be considered adjusted to his blindness. In many cases, however, it was considered probable and even likely that a satisfactory adjustment would eventually be made. The rating of unadjustable was given when the man was not considered adjusted and when, furthermore, he was not considered adjustable or trainable. Mental defectives and patients who were severely disturbed emotionally were placed in this category. The rating of incorrigible was given when the patient displayed antisocial behavior patterns or serious alcoholism.

In addition to the social-adjustment rating, progress at the Old Farms Hospital was rated on a 4-point scale which represented the difference between the rating at the time of admission and at the time of discharge. The percentage distribution of the patients on this scale in September 1945 was as follows:[33]

	Percent
Superior	0. 0891
Excellent	. 1633
Very satisfactory	. 2326
Satisfactory	. 3168
Unsatisfactory	. 1237
Unadjustable	. 0346
Incorrigible	. 0396

[32] Memorandum, Capt. Alan R. Blackburn, Jr., 17 Sept. 1945, subject: Evaluation of Social Adjustment Trainees CDD'ed to Date, Old Farms Convalescent Hospital.

[33] Annual Report, Training Division, Old Farms Convalescent Hospital, 1945. Prepared by director of training and staff, 28 Jan. 1946.

Up to 17 September 1945, 25 patients had been rated as unsatisfactory, 7 as unadjustable, and 8 as incorrigible.

Twenty-one day evaluation.—After the blinded soldier had been at Old Farms for a period of 21 days, all available data concerning him were assembled for study (appendix D, p. 565), including the following: Information from his medical history, service record and social-background report; results of intelligence, interest, personality, and manipulative tests; reports of interviews; progress notes supplied by teachers and orientors; and any other available information. These various data were analyzed and discussed, and the soldier's plan for the future, if it had already been formed, was also discussed and appraised critically. From this information, it was reasonably simple to make recommendations for courses, field activities, and other occupations for the remaining weeks of the course.

Final statement.—At the end of the training period, a final statement was prepared which was a summary of the status of the soldier at the time of his

Old Farms Convalescent Hospital (Special)

AVON, CONNECTICUT

It is hereby certified that

_____

has attained in a satisfactory manner the standards of social adjustment established by the War Department at Old Farms Convalescent Hospital (Special).

Issued on this ____ day of _____ 19____.

_____ *DIRECTOR OF TRAINING*

_____ *COMMANDING*

FIGURE 31.—Old Farms Convalescent Hospital Certificate of Achievement.

discharge from Old Farms (appendix D, p. 567). This statement, together with all the original records developed at this installation and at the eye center at which the man had been hospitalized, was handed over to the representative of the Veterans' Administration assigned to Old Farms for immediate forwarding to the appropriate regional office of the Administration.

A certificate of achievement (fig. 31) was granted to patients who had made a satisfactory social adjustment as indicated by their having met the following requirements:

1. Attendance on at least 75 percent of all courses for the entire period of training.
2. Completion of one major course in the field of interest with a grade of at least satisfactory.
3. Completion of the orientation course (mobile and personal) with a grade of at least satisfactory.
4. Completion of the typing test with a grade of at least satisfactory.
5. Completion of the indicated tryout, achievement, aptitude, and special tests.
6. Reasonably good conformity with the rules and regulations of the hospital, to indicate that the man had fitted into the community.

Liaison With Veterans' Administration

A close relationship was maintained between the general hospitals designated as eye centers and the Veterans' Administration which was responsible for blinded casualties on their discharge from the Army. Tangible results, however, were somewhat disappointing, chiefly because the Veterans' Administration was not equipped to handle the load. As a result, a discouraging gap existed between the soldier's discharge from the Army on a Certificate of Disability and the time he was taken over by the Veterans' Administration.

When Old Farms Convalescent Hospital was opened, one of the first problems was to identify and bring back for training approximately 90 blinded men who had been discharged from the Army before this hospital was functioning, without the special training it was now equipped and staffed to provide. On 7 December 1944, the Deputy Surgeon General called these facts to the attention of the Administrator of Veterans' Affairs and stated that it was planned to set aside, in the new special hospital, a certain number of beds for the veterans in this group who might desire to take advantage of this special training.

Provision for these men, however, did not solve the problem of shortening the gap between the time the casualty was discharged from the Army and the time the Veterans' Administration assumed the responsibility for him.[34] An

[34] (1) Memorandum, Maj. M. E. Randolph, MC, for The Surgeon General, 14 Sept. 1944, subject: Report of Visit of Maj. M. E. Randolph, MC, to Old Farms Convalescent Hospital, Avon, Conn., 11-12 Sept. 1944. (2) Memorandum, Maj. M. E. Randolph, MC, for General Rankin, 18 Nov. 1944.

analysis of the first group of casualties discharged from Old Farms Convalescent Hospital indicated that the gap still existed and that if it were not bridged much of the good work done at the convalescent hospital might be undone. The plan was therefore conceived of working in cooperation with the Selective Service System, beginning with the system in Connecticut.[35] Here the plan worked so well that expanded plans were made to use the machinery of the Selective Service System throughout the country. These could not be carried through, however, since, when they were submitted to the Veterans' Administration, approval was withheld on the ground that it was not the responsibility of selective service to render this particular service.

On 3 January 1945, The Surgeon General called to the attention of the Administrator of Veterans' Affairs the following paragraphs from a report made by Dr. Harry S. Gradle and Dr. Alan C. Woods, civilian consultants in ophthalmology, following an inspection of Old Farms Convalescent Hospital (Special):

> c. There is a crying need for a follow-up service in this hospital. At present, after discharge from the Army, these blinded soldiers receive a pension of $190 per month * * * * There is undoubtedly a tendency for the discharged trainee to follow the course of least resistance, to subsist upon his pension, and so become more or less a useless citizen. Under the present arrangement the discharged trainee, if he wishes placement in industry, must apply to the Veterans Bureau for such help. There appears to be considerable delay between the time such an application is filed and the time it is picked up and acted upon by the Veterans Bureau. Furthermore, if no application is made by the trainee, he is left to his own devices and there is no present method of checking up on his ultimate fate. To meet this end, we feel that there should be first:— a definite speeding up in the placement service of the Veterans Bureau to eliminate lost time between discharge of the trainee from the Army and placement in industry. The delay as now existing appears to be destructive to the morale of the soldier. Second:- we feel there should be some method of checking up on a) the occupation or fate of those trainees who do not apply to the Veterans Bureau for placement, and b) the success or failure of the trainees placed in industry by the Veterans Bureau. This follow-up service would appear to be the duty of the Veterans Bureau. It might well be accomplished by giving greater freedom of action and authority to the Veterans Bureau's representative allocated to the Old Farms Convalescent Hospital * * * * It is recommended that proper representation be made to the Veterans Bureau for the institution of a proper follow-up service. Only by such a service can the success or failure of this rehabilitation program be properly judged.
>
> d. At present, the Veterans Bureau has authority for returning to the Old Farms Convalescent Hospital discharged soldiers and sailors who may require further special training for a civilian occupation. It does not appear that this authority is utilized to the extent that it should be.

Early in March 1945, an agreement[36] was drawn up and was confirmed by letters exchanged between the Administrator of Veterans' Affairs and The

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[35] (1) Memorandum, Col. Derrick T. Vail, MC, senior consultant in ophthalmology, European Theater of Operations, for The Surgeon General, 15 Jan. 1945, subject: Report of Visit of Col. Derrick T. Vail, MC, to Valley Forge General Hospital, Phoenixville, Pa. and Old Farms Convalescent Hospital (Special), Avon, Conn., 9-13 Jan. 1945. (2) See footnote 34 (2) above.

[36] Agreement respecting the principles and procedures to be applied by personnel of the Army and the Veterans' Administration with reference to the services to be provided for blinded servicemen who are admitted to the Old Farms Convalescent Hospital at Avon, Conn. 6 Mar. 1945.

Surgeon General which coordinated the two agencies for the blind in an effective fashion. As the result of this agreement, the Veterans' Administration assigned to Old Farms Convalescent Hospital two of its staff whose duties would be to become acquainted with each blinded man's background, training, education, abilities, response to orientation, and rehabilitation, and similar matters, so that on his discharge from the Army there would be no delay in making contact with him and seeing that he was properly placed. The Veterans' Administration also agreed to supply the blinded soldier, while he was still at the special hospital, with a portable typewriter (which might be standard or Braille), a Braille slate, and a Braille watch. In May 1945, a warrant officer assigned to the Old Farms Hospital, who was thoroughly familiar both with the program for the blind and with the machinery of the Veterans' Administration, was released from the Army and was assigned to the Veterans' Administration to serve as assistant supervisor of an agency for the blind within the Administration.

The agreement signed 6 March 1945 by the Veterans' Administration and the Office of the Surgeon General proved to be excellent both in principle and in working procedure. After it had become fully operative, almost all the soldiers who desired vocational advice and help in placement in either school or employment received such help before they left Old Farms Hospital. In many instances, final arrangements were made before they were discharged. Implementation of the agreement necessarily took place gradually, but it was evident from the first that it would be successful.

Followup

On 14 September 1945, a followup study was reported on the current status of 77 blinded casualties who had been discharged from Old Farms Convalescent Hospital a sufficiently long time before to have carried out plans for the future. Forty-seven were not working or studying at this time. Of this number, 1 was in training for construction work, 11 were planning to train for special occupations, and 6 were planning to continue their studies. One had failed to report for a job in which he had been placed. One was recovering from eczema and one was in hospital. Two did not regard themselves as well enough to work, and six were resting. Two were settling their personal affairs. One was undecided concerning his future plans. Three intended to work later, and three were actively seeking work. Seven were unwilling to work, including one man who refused to see the interviewer. One man was traveling, and another was hitchhiking.

The 30 blinded casualties working at this time were engaged in a wide variety of occupations. One had his own insurance business, one his own grocery, four their own farms, and two their own poultry business. One was working on his father's farm. One was a tax collector. One was operating a concession stand. One was a teacher of the blind. Five were working in

factories doing machine work, one was doing asembly work, and two were working in electric shops. One was working in a transportation company and one in a restaurant. One played in an orchestra. One was a stock clerk. The remainder were, variously, a leatherworker, a guard, a radio repairman, a bus mechanic, a rope manufacturer, and a stamper.

Evaluation of the Training Program

The original program for Old Farms Convalescent Hospital (Special) was prepared in June 1944. It was revised in January 1945 and again in June 1945.[37] Fundamentally, however, the original principles and methods of social-adjustment training were not changed in the revisions. They were merely better defined and strengthened as experience proved their value and practicability. The basis of the program remained, as it had been originally, to restore self-confidence through activity and to train the blinded man actually to do things in the real world, with normal human beings, under conditions of competition. Motivation for the program was provided by stimulation of the soldier's interest in his own future.

HONORARY CIVILIAN ADVISORY COMMITTEE

In March 1945, The Surgeon General appointed an Honorary Civilian Advisory Committee. It was the function of this committee to survey, from time to time, the Army program for the blind. The members, all of whom were prominent in work among the blind, consisted of the following: Dr. Robert B. Irwin, New York, chairman; Joseph G. Cauffman, Philadelphia, secretary; Col. E. A. Baker, Toronto; Rev. T. J. Carroll, Boston; Dr. R. S. Cheek, Raleigh, N. C.; Dr. G. Farrell, Watertown, Mass.; P. N. Harrison, Harrisburg, Pa.; Mrs. L. Johnston, Jefferson City, Mo.; R. Henry P. Johnson, Tampa, Fla.; W. L. McDaniel, Washington, D. C.; E. J. Palmer, Batavia, N. Y.; and Peter J. Salmon, Brooklyn, N. Y.

At the organization meeting 21 March 1945, three representatives were chosen from the membership to visit Dibble and Valley Forge General Hospitals and Avon Old Farms Convalescent Hospital. The report of their visits contained many practical and useful suggestions for the improvement of the blind program. The most important contribution made by the committee, however, was its assistance in establishing a liaison between the Army and civilian agencies in the field of the blind and in enlisting the cooperation of civilian workers, which was particularly necessary for the Veterans' Administration phase of the blind program.

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[37] Under date of 8 April 1946, Capt. Alan R. Blackburn, Jr., MAC, director of training at Old Farms Convalescent Hospital, provided an evaluation of the activities of the hospital (appendix E, p. 569).

SUMMARY

The program for the rehabilitation of the blinded in World War II embodied a new concept of the responsibility of an army for these casualties. The point of view was necessarily maintained that, from the standpoint of useful manpower, which is an army's chief concern, a blinded soldier was of no further value to the armed services. In the early months of the war, he was therefore discharged from service as promptly as possible (that is, as soon as his wounds were healed) to the Veterans' Administration, which was charged with the responsibility of his rehabilitation.

As the war progressed, the policy of prompt discharge was discarded, and the blinded soldier was retained in an Army hospital until he had achieved maximum benefits from hospitalization. During this period of hospitalization, his actual rehabilitation was begun. This policy, however, while an improvement over the earlier policy, still did not completely solve the blinded casualty's problem. The gap between his discharge and the assumption of responsibility for him by the Veterans' Administration was still too great. Moreover, the Veterans' Administration did not have the personnel nor the facilities for the completion of his rehabilitation and for his social adjustment.

The final step in the program for blinded casualties was the establishment of a convalescent hospital with facilities and personnel to carry out these objectives. Thereafter, the blinded soldier was not released either to civilian life or to the Veterans' Administration until he had been put into the best possible physical and mental condition, until he had received all possible benefits from the extensive Army facilities for medical and surgical care, and until he had been taught the special techniques of living which the blinded man must know.

CHAPTER X

The Management of Intraocular Foreign Bodies in Zone of Interior

Gilbert C. Struble, M. D.

In World War I, wounds of the eye were estimated to number 8 percent of all injuries, a rather surprising proportion in view of the fact that the exposed ocular surface comprises only about 1/400 of the total body surface.[1] Trench fighting was thought to have contributed to the high incidence of this type of injury.

In World War II, the incidence of intraocular foreign bodies was also high for a number of reasons, including the extensive use of land and water mines, boobytraps, grenades, rocket projectiles and mortar shells; the introduction of V-type weapons; the increased tempo of aerial warfare, the use of suicide planes, and the added weight of modern bombs and bomb loads; the use of plexiglass in planes; and the possibility of injury by falling masonry, flying glass, and wood splinters. The factor of allied aerial superiority had a good deal to do, for obvious reasons, with the incidence of intraocular foreign bodies.

Lagrange,[2] in 1917, pointed out that battle injuries of the eye are likely to be severe. It was not unusual, in World War I, for one or more through-and-through injuries to be incurred, in addition to the retention of single or multiple fragments. Severe indirect injuries were also frequent, as the result of fractures of the bony orbit and also as the result of simultaneous concussion and blast injury. The increased velocity of modern weapons made these types of injury even more common in World War II. It was not infrequent to observe, in the absence of actual ocular penetration, such damage as dislocation of the lens; traumatic cataract; hyphemia; massive vitreous hemorrhage; rupture of the choroid and retina; retinal detachment; traumatic chorioretinitis, especially involving the macular area; and severe orbital hemorrhage with proptosis and eventual optic atrophy. When damage of this kind was present in addition to the presence of foreign bodies, the prognosis was always extremely grave.

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[1] War Injuries of the Eye. M. J. Australia 1: 61-64 (supplement 16, May 29) 1943. (The cited 8 percent is based on World War I experience for 1914-18. In the American Expeditionary Forces, 1917-18, eye injuries accounted for 1.4 percent of the 153,537 admissions for battle injuries, excluding gas casualties.)

[2] Lagrange, F.: Les Fractures de l'Orbite par Projectiles de Guerre. Paris: Masson et Cie., 1917.

The terrific wounding effects of modern high-velocity missiles always had to be taken into account in ocular injuries. Callender,[3] whose work was based largely on ballistic studies made in World War I, pointed out that the wounding effect of a missile equals the cube of its velocity. He estimated that the wounding effect of a 112-grain bullet from a modern rifle in passing through the hips of a goat is equivalent to approximately 19,850 horsepower. He also called attention to the fact that small fragments flying off high-explosive shells have striking velocities near the bursting point of the shell, or more than twice the initial velocity of the rifle bullet. The fact that the wounding power of a missile equals the cube of its velocity explains how severe ocular disorganization can occur when even very small metal fragments enter the orbit at extreme velocities and have no contact with the eyeball.

COMPOSITION OF INTRAOCULAR FOREIGN BODIES

The great importance of nonmagnetic foreign bodies which lodged within the eye in World War II is clear from the experience at the Crile General Hospital Eye Center. Of the 62 casualties operated on for removal of intraocular foreign bodies between 10 March and 1 December 1945, 25 had nonmagnetic foreign bodies in their eyes (table 5).

This experience was entirely in accord with the observations of Wilder[4] at the Army Institute of Pathology, who reported that, of the foreign bodies removed from *150 enucleated* eyes and subjected to a magnet test, 89 proved to be nonmagnetic. Moreover, several of the 61 objects listed as magnetic appeared to be low in iron content and responded only weakly to the magnet until they were cleaned and dried. Copper, lead, glass, vegetable matter, wool, cotton fibers, and eyelashes were identified in the objects removed. The cotton fibers and eyelashes, which were identified by microscopic examination, were present in association with other foreign bodies. At the time of the publication of Wilder's investigation, a miscellany of unidentified material was still being analyzed by the Institute, which was being aided in the project by the Federal Bureau of Investigation.

In Wilder's study of 150 enucleated eyes, there were recorded 28 instances in which attempts at magnetic removal of foreign objects had failed or partially failed. Since case histories in the study were incomplete, it is unknown how many additional attempts had been made and what degree of clinical success had been achieved. In one case in the series in which 50 small fragments had been extracted at operation, multiple minute magnetic foreign bodies were still present in the enucleated eye on gross examination, and microscopic examination revealed multiple crystalloid particles, fibers, and cilia. Wilder's

[3] Callender, G. R.: Wound Ballistics; Mechanism of Production of Wounds by Small Arms Bullets and Shell Fragments. War Med. 3: 337-350, April 1943.

[4] Wilder, H. C.: (1) Intraocular Foreign Bodies. Bull. U. S. Army M. Dept. 4: 9-10, July 1945. (2) Intraocular Foreign Bodies in Soldiers. Am. J. Ophth. 31: 57-64, January 1948. (3) Tr. Am. Acad. Ophth. 51: 585-593, July-August 1947.

TABLE 5.—*Causative agent and composition of foreign bodies removed from injured eyes at Crile General Hospital, 10 March 1945–1 December 1945*

Causative agent	Composition	
	Magnetic	Nonmagnetic
Mine fragments	3	3
Bullet fragments	1	3
Grenade fragments	4	1
Mortar-shell fragments	5	1
Heavy artillery-shell fragments	13	9
Aircraft-bomb fragments	1	----
Detonator-cap fragments	----	3
Bazooka-shell fragments	5	3
Rocket-shell fragments	1	----
Tire-iron fragments	1	----
Tank-armor fragments	1	----
Jeep fragments	1	----
Nitrostarch signal bound with copper wire	----	1
Missile unknown	1	1

conclusion is undoubtedly correct, that failure of magnet extraction as an operative procedure could sometimes be explained by unexpectedly large numbers of primary nonmagnetic missiles, by the low iron content of some of the magnetic foreign bodies, and by the frequent presence of secondary nonmagnetic missiles.

In World War II, it was not unusual for both eyes to be injured by intraocular foreign bodies, particularly when the injury had resulted from the explosion of a land mine. Such cases were seen by United States ophthalmologists at the Crile General Hospital Eye Center and elsewhere and also by German ophthalmologists. Rohrschneider[5] stated, in 1942, that mine injuries were responsible for 21 percent of the ocular injuries in the German Army and that in over half of such injuries both eyes were affected.

Effects of retained foreign bodies.—A question which always arose in connection with the eventual disposition of a pateint with retained intraocular nonmagnetic particles concerned future outlook. It was an important consideration, even when the eyes had remained white and quiet and the patient had varying degrees of vision up to normal vision. Prewar studies furnished some clarification of the problem.

In 1938, Stokes[6] reviewed the histories of 300 cases of intraocular foreign bodies, 101 of which had been retained in the globe for periods varying from 1 month to 35 years. In 26 of the 300 cases, the foreign bodies were of nonmag-

[5] Rohrschneider, W.: Die Wirkung neuzeitlicher Waffen bei den Kriegsverletzungen der Augen. Deut. Militärarzt 7: 417–423, July 1942. Abstract *in* Bull. War. Med. 3: 270–271, January 1943.

[6] Stokes, W. H.: Retained Intraocular Foreign Bodies; A Clinical Study, with a Review of Three Hundred Cases. Arch. Ophth. 19: 205–217, February 1938.

netic composition, consisting of copper in 13 instances, brass in 5, lead in 5, glass in 2, and stone in 1. It appeared that the location of the particle within the globe determined the possibility of its retention without causing serious complications. It was observed that when the foreign body was lodged in the anterior chamber of the eye it might be retained for a number of years with preservation of normal vision. Likewise, when the foreign body was located in the retina, or retina and sclera, it could be well tolerated. However, when the particle was retained in the vitreous chamber, complications always arose which led to destruction of vision due to uveitis or panophthalmitis and to eventual loss of the eye. Also, regardless of its location, the retention of a brass particle in the globe led, in all instances, to enucleation. In four cases in which siderosis was present, the condition disappeared completely a year after the foreign body had been removed.

As a result of this study, Stokes found no support for the view that the retention of a foreign body in one eye causes sympathetic inflammation in the other; on the contrary, sympathetic ophthalmia developed in his series only when there had been ill-advised efforts at removal. He concluded, therefore, that when the composition and location of an intraocular foreign body are favorable, it may be retained, perhaps for the entire lifetime of the patient, without exciting the eye or disturbing normal vision. "One may assume," he stated, "that such a patient could not have fared better had intervention been adopted * * *. However, the patient must be under the observation and care of a competent oculist for a period of years."

The relative inertness of various materials was summarized by Savin [7] in 1943. Gold and quartz are inert. Iron and steel cause siderosis. Copper may produce cataractous changes, especially posterior cortical opacities, as the result of chemical action. Glass may remain quiet for 10 to 15 years but sometimes causes a violent reaction. A particle of coal may remain quiescent for years, as may eyelashes, unless they form the nucleus for epithelial cysts or pearl tumors. Aluminum alloys are likely to produce iritis, adhesions, and opacities of the lens as the result of mild chemical irritation. It was Savin's opinion that an attempt should always be made to remove brass or copper fragments retained in the globe. He recommended a scleral incision and the use of forceps guided by the electric ophthalmoscope.

LOCALIZATION OF FOREIGN BODIES

Localizing Techniques

Every patient with battle injuries of the head was examined roentgenologically to determine whether intraocular foreign bodies were present. It was a

[7] Savin, L. H.: Treatment of Perforating Ocular Injuries. M. Press 209: 134-138, 3 Mar. 1943. Abstract *in* Arch. Ophth. 34: 338, October 1945.

rather frequent experience to find them in the eyes of patients with 20/20 vision and quiet eyes, who had no history of ocular injuries.

Roentgenologic examination was followed by localization studies whenever foreign bodies were found. These studies were always time consuming; at the Crile General Hospital Eye Center they sometimes required as much as 6 hours of continuous work on the part of the roentgenologist. The length of time consumed, however, is not surprising when it is recollected that sometimes as many as 150 or more radiopaque particles were found in the region of the orbit at the time the preliminary scout film was made and that many of the particles were of microscopic size.

The localizing techniques employed at the eye centers in the Zone of Interior were for the most part those already tested by experience. The Sweet method continued to prove as satisfactory as any method. The supplemental technique devised by Maj. Paul C. Langan, MC,[8] proved of great value in cases in which numerous radiopaque particles were demonstrated in the orbit. This technique was offered simply as a method of shortening the search by eliminating many of the particles from consideration. It is carried out as follows:

> A twenty-five cent piece is about the diameter of the eyeball, which is fairly round, discounting the bulge anterior which amounts to about 1 mm. The Sweet localizer depends partly on the fact that after the ball-cone mechanism is "tripped," the ball is one centimeter from the cornea and its rod is aimed in the mid-vertical, mid-horizontal plane intersection. If the arm for the ball shadow is projected and a perpendicular is erected to it at 1 cm. from the shadow, it should be tangential to the cornea. This relationship is not changed by the tube shift toward the feet. Allowing 1 mm. for the bulge, a twenty-five cent piece may be placed on the film in such a manner that the projected line passes through the center of the coin. A light pencil line drawn around the coin will outline, approximately, the eyeball. This may be done on the second view as well. All shadows falling within both of the circles should be localized, as should any which fall at the rim or just beyond it. Many will be to the nasal side or the temporal, but any which fall outside on one or the other, or both, need not be charted, thus shortening the work and diminishing the number of shadows which must be identified on both views as being due to the same foreign body.
>
> It must be stressed that all foreign bodies appearing in both of the circles are not necessarily in the eyeball, and complete plotting should be carried out for them.

Jervey,[9] in 1944, described an original method for the localization of radiopaque foreign bodies in the globe. After the globe had been anesthetized, a curved eye needle which accurately fits the curve of the globe at the limbus is selected. The point of the needle is inserted beneath the conjunctiva at the limbus, at a point 5 mm. from its final desired position. The needle is then inserted beneath the conjunctiva for an additional 5 mm. Lateral and anteroposterior roentgenograms are made at a distance of 30 inches, with the tube centered over the affected eye. It is essential that the eyes be fixed in

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[8] Aid in Localization of Foreign Body in the Eye. Bull. U. S. Army M. Dept. 4: 8-9, July 1945.

[9] Jervey, J. W., Jr.: A Simple Method of Localizing Intra-ocular Radiopaque Foreign Bodies. Eye, Ear, Nose & Throat Monthly 23: 269-270, July 1944.

the straight ahead position. Jervey claimed that measurements made by this method are quite accurate, because distortion at 30 inches is negligible.

Another aid to localization, suggested by Spaeth,[10] consists of suturing metallic rings (6, 14, 18, and 20 mm. in diameter) on the sclera before anteroposterior roentgenograms are made. Spaeth also advocated the use of stereoscopic roentgenograms in preference to single-plane films in certain cases of intraocular foreign bodies. Maj. Harold G. Scheie, MC,[11] advocated the injection of oxygen into Tenon's capsule before roentgenography as an aid to localization in obscure cases.

Most of the ophthalmologists who served in World War II had had some previous experience with the Comberg contact-lens technique for the localization of intraocular metallic foreign bodies. This method consists of placing a contact lens with four lead markers on the cornea before taking lateral and posteroanterior roentgenograms with the patient in the chin-nose position. The measurements secured from these two views are plotted on a sectional and on an anterior chart of the globe. The film measurements must be reduced by a corrective factor of 10 percent to allow for distortion resulting from the distance between the film and the object.

Thorpe,[12] who devised a modification of the method, pointed out the following inherent faults in the Comberg lens: (1) It is made of glass and is therefore fragile; (2) it may be pushed downward by the upper lid and thus assume a position in which the contact lens and the visual axis are not coaxial; and (3) it is sometimes difficult to remove because suction develops between it and the eyeball. Thorpe's lens is made of plastic, and 3 small holes are drilled in the margin at 3, 6, and 9 o'clock so that it can be anchored to the globe by scleral sutures. A small venthole drilled just inside the limbus permits easy removal of the lens from a traumatized globe.

Locators

The Berman locator, which was available at some of the eye centers in the Zone of Interior, was described by Minsky [13] as follows:

> In a diagnostic rod is placed the equivalent of two transformers—one in the handle and the other at the tip, which is used to search for the foreign body. The primary coils are connected in series to a source of alternating current. Also in series, the secondary coils are connected through an amplifying unit to a voltmeter. When an alternating current is sent through the primary coils, a current is produced in the secondary coils by induction. The instrument has a means of equalizing (balancing out) the voltages in the secondary coils so that the needle of the voltmeter will read approximately zero, since no current

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[10] Spaeth, E. B.: Removal of Metallic Foreign Bodies from the Eyeball and Orbit. J. A. M. A. 120: 659–666, 31 Oct. 1942.

[11] Scheie, H. G., and Hodes, P. J.: Injection of Oxygen Into Tenon's Capsule. Arch. Ophth. 35: 13–14 January 1946.

[12] Thorpe, H. E.: Shell for Roentgenographic Localization of Intraocular Foreign Bodies; Modification of Comberg's Contact Lens. Arch. Ophth. 32: 497, December 1944.

[13] Minsky, H.: Transscleral Removal of Intraocular Foreign Body With the Aid of the Berman Locator. Arch. Ophth. 31: 207–210, March 1944.

flows between them. Now, if the coil in the tip of the rod approaches a magnetic metal (the foreign body), the balanced inductance is disturbed and a difference in potential takes place in the secondary circuit, which results in a flow of current. The amount of this current, shown by the deflection of the needle in the voltmeter, varies with the size of the metallic particle and with its distance from the tip. At the greatest point of deflection, therefore, the tip of the locator is immediately over the foreign body. Conversely, as the locator travels away from the foreign body, the deflection of the needle is lessened. . . . The instrument responds best to iron and steel, and less effectively to copper, brass, silver, aluminum, lead and their combinations. The differentiation of a nonmagnetic foreign body from a magnetic one is easily made when the needle of the voltmeter does not move at all.

The Berman locator at the Valley Forge General Hospital Eye Center was provided with a sound attachment which permitted an auditory response when the [illegible] was brought within range of the magnetic foreign body, in addition to the visual response registered on the dial indicator. The conclusions of Maj. Albert J. Abbott, MC, concerning this particular instrument were as follows: [14]

1. The Berman locator will determine whether or not the foreign body is magnetic.
2. When the exposure is such as to permit adequate manipulation of the instrument, localization can be accurately performed.
3. The data obtained by the use of the locator when correlated with the history, clinical findings, X-ray localization and diagnostic application of the magnet, give the ophthalmologist additional evidence on which to evaluate an intraocular foreign body problem.
4. The use of the instrument is simple and rapid and provides a quick means of checking the position of a foreign body after application of the magnet.
5. Foreign bodies located near the posterior pole of the eyeball lend themselves less well to the use of the locator than those more anteriorly located.
6. Multiple magnetic fragments in the orbit or in the tissues adjacent to the globe may prevent satisfactory use of the instrument.

Ocular Endoscope

The ocular endoscope devised by Thorpe,[15] on the principle of the cystoscope and the pharyngoscope, was also used in the management of intraocular foreign bodies. This instrument is a specially designed inverted Galileon telescope combined with a source of illumination and a fine forceps. It is 2.5 mm. in diameter and permits a view of a field 12 mm. in diameter at a distance of 1 inch. The shape and size of the intraocular foreign body determines the type of jaws for the forceps. A scissors attachment can be used to cut vitreous bands under direct vision. A scleral incision 8 mm. long is required to admit the end of the instrument.

With the aid of the ocular endoscope, according to Thorpe, a direct view of the interior of the globe is possible, and, with a minimum manipulation of small instruments, the amount of guessing in the search for nonmagnetic intravitreous foreign bodies is minimized and their removal is facilitated.

[14] Abbott, A. J.: The Use of the Berman Locator in the Removal of Intra-ocular Metallic Foreign Bodies. Read at the Military Ophthalmological Meeting, Crile General Hospital, 30 Nov. 1945.

[15] Thrope, H. E.: Ocular Endoscope. Tr. Sect. Ophth. A. M. A., 1934, pp. 290–291.

Factors of Error

According to Schwartz,[16] the factor of error in the roentgenographic estimation of the position of an intraocular foreign body ranges between 5 and 10 percent. This error, according to Minsky, is increased whenever it is necessary to use calipers, protractor, millimeter rule, and meridional angles to mark a point on the sclera corresponding to the plotting on a chart. The experience of Army ophthalmologists was in accord with these observations. This was in no way a reflection on the work of the roentgenologist. As a matter of fact, it was often extremely difficult to mark on the sclera the exact site indicated by the localization chart. Marking was especially difficult when the foreign body was apparently far posterior and when the globe had to be displaced markedly to one side.

It was found that the accuracy of roentgenologic localization was also likely to be lowered by the presence of one or more of the following conditions: (1) Orbital variations caused by loss or displacement of any of the orbital walls and resulting in an abnormal position of the globe; (2) ocular deviations, such as very poor vision, nystagmus, strabismus, photophobia, or pain, which made the patient unable to keep the lids open or the eye from drifting during the localization procedure; and (3) abnormalities in the volume of the globe, which might be due to atrophy as well as injury, and which were often not visible from the front (as in cases where flattening of the globe was limited to the area of a puckered scleral wound). In instances of globe abnormalities, even a slight variation might cause serious inaccuracies in localization.

For these reasons, Army ophthalmologists believed that localization by the Berman locator or some similar technique was definitely indicated, in addition to roentgenologic localization, in certain instances of intraocular foreign bodies.

The check localization technique described by Lt. Col. Gilbert C. Struble, MC, and Capt. L. J. Croll, MC,[17] consists of affixing a piece of lead shaving to a black silk eye suture which is sewed to the sclera at the point indicated by previous roentgenologic localization. Posteroanterior and lateral roentgenograms, with the patient's eyes in the primary position, are taken in the operating room, with the portable X-ray machine. If an ocular muscle has been detached, it is temporarily secured to its normal attachment while the films are being taken. Any previously placed muscle sutures are kept sterile by placing them in a sterile test tube anchored below the patient's nose with a strip of adhesive plaster. If rapid developer solution is used by the X-ray department, the films taken in the operating room can be returned for examination in their wet state within 8 minutes from the time they are taken. No break in sterile technique need occur if the cassette is placed under a sterile towel while the

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[16] Cited by Minsky, see footnote 13, p. 216.

[17] Struble, G. C., and Croll, L. J.: Technical Refinements in the Removal of Magnetic Foreign Bodies From the Posterior Segment of the Eye. Am. J. Ophth. 29: 151-161, February 1946.

pictures are being made, and no time is lost if the patient is redraped while the films are being developed. It is important that the lead marker used be approximately 2.5 by 2 mm. in size, or any other size different from that of the retained intraocular foreign body, so that it will be at once evident, when the films are read, which is the marker and which is the foreign body.

It is at once evident from the check posteroanterior film whether the foreign body has been missed in the vertical or the horizontal plane, and at once evident from the lateral film whether any error has been made in the anteroposterior or vertical meridian. If an error exists, it is a simple matter to make the correction indicated from the known location of the marker. At the Crile General Hospital Eye Center, this method was found particularly useful in cases in which repeated localizations varied 1 to 2 mm. and placed the particle either in or out of the globe. It was also useful in cases in which it was believed that the fragment was embedded in the ciliary body, choroid, or retina. Foreign bodies in these regions always require particularly precise localization (p. 222).

SURGICAL MANAGEMENT

Indications

A number of considerations, including local circumstances, determined the rationale of therapy of intraocular foreign bodies during wartime, just as during times of peace. The basic principle was that no fragments should be left in the eye longer than was necessary. The numerous authenticated instances of salvage of the eye by prompt removal of foreign bodies substantiated that principle.

One favorable circumstance concerning certain intraocular foreign bodies was pointed out by Tisher,[18] who stated that metallic particles striking the eye "are sterile due to terrific heat created when the particle flies off the mother object, due to cleavage of the crystalline structure from two metals striking each other." He was referring to the industrial accidents of peacetime, it is true, but his remarks are even more applicable to battle casualties, since it is probable that flying metal fragments from exploding missiles may be additionally sterilized by the terrific heat of the explosion.

The policy in World War II was to give casualties with intraocular foreign bodies first priority in evacuation to centers where expert ophthalmic care was possible but not to regard them as emergencies requiring surgical intervention in forward areas. Emergency care in forward installations was limited to gentle cleansing of the eyes, instillation of atropine and of a sulfonamide or penicillin ointment, and the application of a sterile dressing, together with treatment for battle shock and coexisting injuries. The patient was then

[18] Tisher, P. W.: Industrial Injuries of the Eye Caused by Flying Objects. Arch. Ophth. 33: 152–154, February 1945

evacuated, as rapidly as possible, to an installation at which accurate, skilled, definitive care of the ocular injury was possible.

For clinical purposes, foreign bodies within the eye were classified according to location into (1) those affecting the anterior segment and sclera, including the bulbar conjunctiva, the exposed sclera, the cornea, the anterior chamber, and the iris; and (2) those affecting the posterior segment, including the lens, the ciliary body, the posterior chamber, the vitreous, the choroid, the retina, the posterior sclera, and the optic-nerve head.

The Anterior Segment

The cornea. — In numerous instances, single or multiple foreign bodies in one eye or in both involved only the superficial layers of epithelium. Frequently, in such instances, the bodies were extruded spontaneously and with less scarring than if efforts had been made to remove them. Particles embedded in the epithelium were removed, together with the surrounding ring stains, by means of a loupe, with adequate illumination and the proper instruments. In the course of the war, as an aid in this procedure, Gillette[19] advocated a 1- to 3-second application with a fine cotton wisp of 1-percent silver nitrate solution to the embedded foreign body and the immediately adjacent cornea. In his experience, this method conserved time and function by facilitating removal of the foreign body, and of the burn and stain, from the corneal epithelium. The ring stain was usually easily removed, the results being better the sooner after injury that treatment was carried out.

Soon after this method was introduced, Culler[20] warned that, if sulfathiazole was used in the eye after silver nitrate had been applied, a permanent opacity of the cornea might result at the site of the application because of the formation of an insoluble precipitate when the sulfathiazole came into contact with the silver nitrate. This precipitate was believed to be either silver sulfathiazole or the silver salt of aminothiazole. Culler's warning, that caution should be used in the application of silver nitrate to the cornea if Bowman's membrane was broken and sulfathiazole was used, seemed well founded.

Foreign bodies embedded in the middle layers of the cornea were removed by means of a loupe and a knife needle, under a brilliant light. It was found preferable to remove these particles under direct slit-lamp observation. Sometimes, multiple sittings were necessary.

Particles lying deep in the cornea, on or in Descemet's membrane and the posterior corneal endothelium, could be safely watched for a time if there were no apparent symptoms. Siderosis developed, however, if the particles were iron, and in such cases their eventual removal became necessary.

Other indications for removal of particles in the cornea included the

[19] Gillette, D. F.: A New Aid in Removal of Foreign Bodies of the Cornea; Topical Applications of Silver Nitrate. Arch. Ophth. 31: 129-133, February 1944.

[20] Culler, A. M.: Incompatability of Silver Nitrate and Sulfathiazole. Arch. Ophth. 33: 317, April 1945.

development or persistence of endothelial changes, the development of an aqueous flare, and the presence of cells in the anterior chamber, together with photophobia and general irritation of the globe. If the eye remained entirely quiet, if the particles were small, and if none of the untoward events just listed seemed to be developing, the foreign bodies were not disturbed.

The bulbar conjunctiva and anterior sclera.—In cases in which multiple tattooing had occurred from powder burns involving the bulbar conjunctiva and anterior sclera, it was found the wisest plan to do nothing, as the marks eventually began to fade and finally, over a period of months, almost disappeared. Particles of sand, small metal fragments, dirt, and similar foreign objects were removed after proper roentgenologic and localizing studies. It was not unusual to find that what appeared to be a small metallic foreign body in the sclera was in reality only the tip of the object lying exposed under the conjunctiva. The remainder of the object plugged a fairly large hole in the sclera and ciliary body and even projected into the posterior chamber. When the surgeon was familiar, in advance of an operation, with the precise situation, he could place preliminary scleral sutures at the margins of the sclerotomy incision and could close the wound as soon as the foreign body was removed. In numerous instances, this precaution prevented loss of vitreous and reduced the possibility of intraocular infection.

The iris.—If foreign bodies in the iris were metallic, the hand magnet was cautiously applied under direct observation with the loupe or, preferably, the slit lamp. If the particle moved and if it was sufficiently large to justify removal, it was extracted by the magnet through a limbal incision. Iridectomy, with excision of the part of the iris containing the foreign body, was sometimes necessary. In many instances, although the surface and stroma of the iris were liberally sprinkled with minute nonmagnetic particles, the eye remained completely quiet, without aqueous flare, endothelial deposits, or cells in the anterior chamber, and with vision normal or almost normal. Such patients were carefully observed and followed up, but in the absence of indications no surgical intervention was undertaken.

The anterior chamber.—Magnetic foreign bodies in the anterior chamber were removed through a limbal section by means of the magnet. The incision in the cornea was also perpendicular. An oblique incision resulted in the formation of a shelf, which made removal of the particle difficult. Nonmagnetic particles could often be removed by irrigation, or with fine forceps. Some nonmagnetic bodies which were small and well tolerated were left in situ, though it was realized that there might be later formation of cysts about them, with blockage of the angle of the chamber.

The Posterior Segment

The lens.—Extraction of the lens was regarded as definitely indicated if a foreign particle could be seen in it or could be localized within it. The ideal

procedure, in such cases, was removal of the lens with the foreign body by the intracapsular technique. Usually, however, this was not possible, and linear extraction was performed in most instances. If the particle was magnetic, it was removed with the curved hand-magnet tip at the time of the extraction of the lens. A nonmagnetic particle, if it could not be removed by irrigation during the extraction, was removed with forceps. Extreme care was necessary in these cases to prevent rupture of the posterior lens capsule or the hyaloid membrane; if either of these accidents occurred, the foreign body was likely to drop back into the vitreous.

If a lens containing a nonmagnetic foreign particle remained clear, except for local opacity along the track of the missile; if the capsule appeared to have closed over the track; if vision remained unaltered; and if no swelling of the lens was apparent, such a particle was merely watched. In two such cases at the Crile General Hospital Eye Center, the patients were followed for more than 4 months. During this period, vision in each case remained between 20/20 and 20/30, the lens opacity did not progress, and there was no evidence of swelling of the lens. In each case, both eyes remained entirely quiet and free from symptoms even though, in one instance, the foreign particle was copper. It was believed that eyes in this condition were of more value to the patients than aphakic eyes would be, and all the experience pointed to the fact that observation under these circumstances was safe.

The posterior chamber.—If a foreign body in the posterior chamber was magnetic, an attempt was made to draw it around the equator of the lens, through the pupil, into the anterior chamber, from which it could be extracted by the technique already described. If it became embedded or entangled, it was removed by means of a peripheral or a complete iridectomy. If the lens was cataractous, the particle could be removed with the tip of the magnet at the time of linear extraction. When efforts to draw the particle into the anterior chamber were unsuccessful or caused undue reaction, particularly in cases in which it was adherent to organizing exudate and hemorrhage, it was removed through an approach through the ciliary body, preferably the pars plana. The approach was made as close to the object as possible by means of the Berman locator or the scleral marker technique.

The ciliary body.—The removal of a particle from the ciliary body was accomplished through a sclerotomy approach directly over the object after its position had been determined either by the Berman locator or by the use of a scleral lead plate marker (pinpoint localization). Careful localization is particularly important when foreign bodies are lodged in this part of the eye. In such cases, if the particle is approached from the side it will, if attracted at all, be dragged toward the magnet in such a manner that a gutter or groove will be torn through the ciliary tissue. Such gross—and unnecessary—trauma to the ciliary body is likely to result in hemorrhage and traumatic cyclitis and probably increases the possibility of sympathetic ophthalmia.

The vitreous.—Many ophthalmic surgeons preferred to remove a particle

in the vitreous through an anterior approach by dragging the object around the lens through the posterior chamber and pupil into the anterior chamber, whence its removal was accomplished by the usual procedure. In numerous instances, this proved to be a satisfactory technique, though it required the employment of a very strong magnet, usually a giant magnet, which was not available at all eye centers.

The possibilities of the anterior route have been well summed up by Moore, as follows:[21] If the foreign body is small (not more than 1.5 mm. in length) and if it has passed through the cornea, with or without injury to the lens, it may be possible to remove it by the anterior route. If it is not embedded in the retina or if it has not been in the eye for more than 24 hours, it can be brought forward into the anterior chamber and removed through the original opening or through a keratome incision. If the foreign body is larger than 1.5 mm. and if it has not injured the lens, it should be removed through an opening in the sclera. An approach over the ora serrata is desirable whenever it is possible because at this point the retina is most firmly attached to the underlying sclera.

The trend in military ophthalmology in World War II, as in civilian practice, was to remove foreign bodies lodged in the posterior segment through a posterior sclerotomy approach, and, whenever possible, particularly when the particles were in the vitreous, to make the approach through the pars plana portion of the ciliary body. The technique popularized by Verhoeff[22] was used. A careful scleral section was made under a conjunctival flap 5 to 6 mm. from the limbus and parallel to the ora serrata. For this purpose, Verhoeff used a large knife needle, the point of which had been filed off. Next, the tissues were carefully dissected down to the ciliary body, particular care being taken not to penetrate it with the knife. The [illegible] the hand magnet was then applied to the operative wound, and the fragment was pulled through the ciliary body. If the particle was small, a small incision in the ciliary body was sometimes required to facilitate its delivery.

There was a good deal of support in favor of these surgical principles. Stallard,[23] on the basis of extensive experience with intraocular foreign bodies in the British Army, believed that, whenever the particles were situated behind the lens, the posterior route of extraction through a scleral incision was the method of choice. About 30 percent of the objects in his series of 102 cases were of low magnetic properties.

For many reasons, both theoretical and practical, the pars plana approach to free-floating foreign bodies in the posterior chamber and vitreous proved a sound procedure. The portion of the ciliary body involved is relatively

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[21] Moore, P. G.: Management of Magnetic Foreign Bodies in the Eye. Ohio State M. J. 40: 26-35, January 1944.

[22] Verhoeff, F. H.: Concerning Magnetic Intraocular Foreign Bodies and Their Removal. Am. J. Ophth. 15: 685-689, August 1932.

[23] Stallard, H. B.: War Surgery of the Eye; An Analysis of 102 Cases of Intraocular Foreign Bodies. Brit. J. Ophth. 28: 105-135, March 1944.

avascular and tolerates surgical procedures extremely well. With this approach, there is little or no risk of injury to the ciliary processes, the suspensory ligaments of the lens, the lenticular tissue, or the iris. Finally, there is little or no risk of retinal detachment following this operation because the retina has not been penetrated.

The technique of the sclerotomy approach employed at the Crile General Hospital Eye Center was devised by Lt. Col. G. C. Struble, MC, and Capt. L. J. Croll, MC,[24] and was carried out in the following manner:

1. After the proposed point of scleral section had been marked, silk retraction sutures were placed on each side of the site of the intended incision. These sutures immobilized the globe and permitted constant, complete control of the operative area. It was possible to apply any desired amount of traction to the lips of the scleral incision without instrument manipulation of the margins and the attendant risk of nicking or penetrating the choroid or ciliary body, which was to be avoided at all costs. During extraction of the foreign body, any desired amount of scleral separation could be maintained without the use of instruments, and the tip of the giant magnet could be easily brought to the operative site on the infrequent occasions when its use was necessary. Finally, the retraction sutures were available for use as supporting sutures, if desired, for closing the sclerotomy incision, and they served as guide sutures during application of the diathermy barrage when the approach was over the choroid.

2. The incision into the sclera, which was about 6 mm. in length, was made between the retraction sutures with the use of a loupe, a brilliant source of light, and a sharp cataract knife. The sclera was carefully divided by layers until approximately four-fifths of its thickness had been cut through. At this point, a double-armed mattress suture of #000 plain catgut was placed at each side of the scleral incision, through both lips of the incision and through half the thickness of the sclera. The sutures were tied loosely with a single tie and were drawn away from the site of the incision, to be used for later approximation of the scleral section, after removal of the foreign body.

3. The incision was then completed down to the uvea, great care being taken not to penetrate or perforate this structure. Dissection was accomplished with the aid of lateral traction on the scleral lips, which made the procedure reasonably simple. As soon as a black uveal bead presented in the incision, which at this level was not more than 2 mm. in length, the blunt tip of a pair of conjunctival scissors was introduced, and the few remaining scleral fibers were severed with a single cut. The blunt posterior aspect of the lower blade of the scissors was used to push the uvea away from the tips of the scissors. Any bleeding encountered in the course of the dissection was controlled by coagulation of the bleeding vessel with the diathermy tip, which

[24] See footnote 17, p. 218.

was always kept available for purposes of hemostasis and later for diathermy barrage around the operative site, if that were indicated.

When the approach was made posteriorly over the choroid, the scleral incision was made in the anteroposterior meridian. When the pars plana approach over the ciliary body was used, the section was made concentrically, and parallel with the ora serrata, 6 to 8 mm. from the limbus. If the particle was embedded in the ciliary body, the section was made directly over it.

4. The broad tip of the small hand magnet was next placed in contact with the uvea. This particular tip was especially designed to give the strongest possible pull on a fragment at a distance, on the principle that the blunter and shorter the pole, the stronger the pull when tested at 20 mm. or more. The 6-mm. incision was adequate to permit a considerable area of the tip of the magnet to be in contact with the surface of the uvea.

The foot switch was then closed, and the foreign body was drawn through the intervening tissues to the tip of the magnet. This was possible because of the well-known fact that a magnetic foreign body always approaches the magnet point first. The object therefore acted as its own perforator and emerged through the smallest opening compatible with its size. Particles 0.5 mm. in size, or larger, if they had been accurately localized, had sufficient impact to perforate the choroid and retina or the pars plana cleanly, usually on the first application of the magnet. Foreign bodies 0.25 mm. in size, while they presented beneath the uvea, usually required a small nick in this layer before they emerged.

It was found that this technique, which avoids entrance into the vitreous with the magnet, has numerous advantages. The risk of infection is reduced to a minimum. Intraocular hemorrhage, with the resultant formation of vitreous bands and the occurrence of late detachment of the retina, is also reduced to a minimum or prevented entirely. This method also permits safe exploration and attempted surgical removal of fragments believed to be nonmagnetic or of low magnetism, and the patient could therefore be assured that, if removal were unsuccessful, the eye would not be injured. This was a particularly important consideration if the eye was quiet, the vision was normal or almost normal, and the foreign body was thought to be aluminum, plastic, or some other substance usually well tolerated by the eye.

5. After the foreign body had been removed, the catgut mattress suture, which had already been placed, was tied, thus securely approximating the scleral margins. The silk retraction sutures on each side of the incision were removed at this point or were left in situ temporarily, to serve as guide sutures in the manipulation of the globe during the final steps of the operation.

6. A diathermy barrage around the site of operation was regarded as indicated only when the operative approach had been over the choroid. Since the retina is in contact with the choroid, the barrage was carried only through the outer two-thirds of the sclera, so as not to injure the underlying retina with the diathermy tip. Surface scleral coagulation with the small ball electrode

could be substituted for the diathermy barrage if this method was preferred, but, if it was used, care had to be taken not to burn the sutures.

Experimental studies.—Struble and Croll,[25] in working out the technique of the procedure just described, carried out experimental studies on the distances at which it was possible to remove intraocular foreign bodies from the vitreous with a hand magnet. Particles of steel shavings, 0.25, 0.5, and 1.0 mm. in diameter were inserted into the vitreous of experimental animals. Results of attempts at removal at various distances were expressed in terms of zones. The first or "certain" zone represented the distance at which the foreign object could always be removed on the first attempt. The certain zone was determined to be as follows:

Distance in millimeters	*Size of object in millimeters*
3	0.25
6	.50
11	1.00

The second or "critical" zone represented the distance at which the fragment could eventually be removed by repeated (several to 10) 5-second applications of the hand magnet. Results for the critical zone were:

Distance in millimeters	*Size of object in millimeters*
7	0.25
10	.50
16	1.00

The third of "failure" zone was defined as lying beyond the limits which had been determined for the critical zone.

The first and second zones thus represent the distances at which particles of various sizes, floating freely in the vitreous, can be consistently removed without uveal penetration by means of the small hand-magnet tip, through the pars plana approach, as well as by the posterior route over the choroid. The latter route would be indicated if a fragment of the size listed occupied a position far posterior in the vitreous, making removal through a pars plana approach impossible. When particles of the sizes mentioned lie in the third zone, the use of a hand magnet is not feasible, and the giant magnet must be resorted to.

In another experiment, Struble and Croll embedded foreign particles in the retina and choroid of experimental animals and attempted to remove them with the magnet by their special technique. The results were inconclusive so far as the possibility of removing the foreign body at a distance greater than 4 mm. was concerned, but one fact was notable. In those experiments in which the fragment was pulled laterally for a distance of 3 or 4 mm. toward the scleral incision and magnet, a tear or gutter was created in the retina or choroid for the length of the track through which the foreign body was moved. When

[25] See footnote 17, p. 218.

the foreign body was embedded in the choroid or retina directly underlying the scleral opening, it could always be pulled through by the magnet on the first attempt, with a minimum of trauma to the tissues. Further support was thus provided, before surgical removal was attempted, for precise localization of metallic particles embedded in these structures.

The choroid and retina.—Foreign bodies in the choroid and retina were removed through a sclerotomy incision directly over the particle, after precise localization with a Berman locator or scleral marker. A diathermy barrage was always placed about the sclerotomy incision, and the patient was observed for possible detachment of the retina. Postoperative care included rest in bed on the affected side for 3 weeks, with both eyes bandaged, and the use of pinhole glasses for a period of 3 months.

POSTOPERATIVE MANAGEMENT

The most common complications following removal of intraocular foreign bodies are infection, in the form of an acute or chronic iridocyclitis or a fulminating panophthalmitis, intraocular hemorrhage into the vitreous or anterior chamber, early or late retinal separation, and sympathetic ophthalmia. A large part of the success attained in the management of these injuries depends upon intelligent postoperative care, and in the eye centers in the Zone of Interior particular attention was always directed to this phase of treatment.

ADJUNCT THERAPY

Chemotherapy and Antibiotic Therapy

Chemotherapy.—The sulfonamides, given locally and systemically, proved valuable agents in the treatment of preoperative and postoperative infections associated with intraocular foreign bodies. Although usages differed, it was generally believed that the most effective sulfonamide for systemic administration was sulfanilamide. Maj. J. G. Bellows, MC,[26] who studied the four most commonly used sulfonamides (sulfanilamide, sulfathiazole, sulfadiazine, and sulfapyridine) found that the highest concentration in ocular tissues could be obtained with sulfanilamide. Except in the cornea and the sclera, the concentration of sulfathiazole and sulfadiazine in the globe was below that of therapeutic effectiveness, though it was enhanced by heat, paracentesis, or the presence of inflammation. Bellows regarded a blood concentration of 5 to 10 mg. of sulfonamide per 100 cc. as sufficient for all infections except those caused by staphylococci, in which much higher concentrations were required. Large doses for short intervals were more effective than small doses for long periods.

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[26] Bellows, J. G. Chemotherapy in Ophthalmology. Arch. Ophth. 29: 888–903, June 1943.

For local administration, Bellows' observations showed, sulfapyridine and sulfathiazole achieved concentrations in the aqueous of half the required therapeutic strength. Penetration could be increased, however, by the use of various organic compounds and wetting agents, such as zephiran chloride. The conclusion was that from the practical standpoint, sulfanilamide and sulfapyridine should be given orally, sulfanilamide should be used topically, or any of these drugs might be used with a wetting agent to provide adequate concentrations.

Lt. Col. Phillips Thygeson, MC,[27] also found sulfanilamide the most soluble and the best distributed of the sulfonamides. He called attention to its toxicity and to its ineffectiveness against the pneumococcus and the staphylococcus. Because sulfadiazine is less toxic than sulfathiazole, he regarded it as the drug of choice for most general infections. Inflammations and paracentesis facilitate its penetration. Thygeson regarded sulfathiazole as the drug of choice for local use. Blood levels of 5 to 10 mg. per 100 cc. were found satisfactory except in staphylococcic infections, in which concentrations of at least 10 mg. per 100 cc. were advised.

Antibiotic therapy.—The ophthalmologist in World War II was particularly fortunate in having at his disposal new antibiotic agents, which, like the new chemotherapeutic agents, undoubtedly had much to do with the lessened incidence of infection.

Penicillin, as soon as it became available, was usually given in doses of 25,000 units every 3 hours day and night for periods of 4 to 7 days after operation. In some cases, it was applied locally. The ophthalmic ointments available commercially, which usually contained 2,500 units of penicillin per gram, proved quite satisfactory for local instillation into the conjunctival sac. In still other cases, penicillin was injected either subconjunctivally or directly into the anterior chamber of the vitreous.

The studies carried out at the Crile General Hospital Eye Center by Lieutenant Colonel Struble and Major Bellows [28] on the distribution of penicillin in ocular tissues showed that high concentrations can be attained in the anterior segment of the globe by local application with the corneal bath or by subconjunctival injections. After the parenteral injection of a single large dose, penicillin could be detected in the eyeball within 15 minutes, the concentration decreasing progressively in the extraocular muscles, sclera, conjunctiva, tears, chorioretinal layer, aqueous humor, vitreous, and cornea. The amount in the vitreous was so small as to be questionable. On the other hand, after the subconjunctival injection of penicillin in a concentration of 2,500 units per cc. of solution, concentrations of 1.9 units per gm. of vitreous could be demonstrated.

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[27] Thygeson, P.: Sulfonamide Compounds in Treatment of Ocular Infections: Review. Arch. Ophth. 29: 1000-1022, June 1943.

[28] Struble, G. C., and Bellows, J. G.: Studies on Distribution of Penicillin in Eye and Its Clinical Application. J. A. M. A. 125: 685-690, 8 July 1944.

Fever Therapy

Fever therapy proved a sightsaving measure in many patients with intraocular foreign bodies. The method employed to achieve results was immaterial, but the attainment of a good febrile reaction was essential. The application of the method was somewhat complicated by the fact that Army personnel reacted erratically to the intravenous injection of triple typhoid vaccine, probably because they were routinely immunized to typhoid and paratyphoid organisms. Occasionally, they apparently had become sensitized to the vaccine, and, when they were treated by fever therapy, unduly high temperatures developed. One patient, for instance, after treatment by intravenous injection of 25,000,000 killed organisms, developed a temperature of 106° F., which persisted for 4 hours. This was exceptional. In most instances, the febrile reaction left much to be desired; usually it did not exceed 100° F. Still another difficulty in the use of triple typhoid vaccine was that it was not always safe to use it on successive days because of the possibility of a secondary reaction on the day following the injection.

Ophthalmologists at the Crile General Hospital therefore recommended the use of artificial fever therapy as a safe and certain method of obtaining definite therapeutic temperature elevations with a minimum of discomfort to the patient. The preferred routine included periods of treatment at a temperature not exceeding 105° F. for not more than 2 hours at a time.

The lack of equipment prevented any general use of artificial fever therapy at the eye centers and, in spite of its disadvantages, triple typhoid vaccine had to be employed. The first dose, for an adult of normal size, was 25,000,000 killed organisms intravenously. The dose was doubled at each subsequent treatment until a level of 200,000,000 organisms was reached. Thereafter, depending upon the patient's reaction, the dose was increased by 100,000,000 organisms at each injection. Treatments were given not oftener than every 72 hours.

If triple typhoid vaccine was contraindicated or was not available, boiled skimmed milk was substituted; it was given by intramuscular injection, at intervals of 72 hours, in doses of 5 to 10 cc.

SYMPATHETIC OPHTHALMIA

Sympathetic ophthalmia was not an important problem in World War I and was even less of a problem in World War II. The experience of one ophthalmologist who, in a service period of 4 years and 8 months, saw only a single case is typical. In this instance, a soldier had incurred a severe penetrating ocular injury overseas, 96 days before his admission to the Crile General Hospital Eye Center. When the patient was first examined at the center, vision in the injured eye was limited to light perception with poor projection. The examination showed occlusion and seclusion of the pupil, a moderate

number of keratic precipitates, a heavy aqueous flare, and secondary glaucoma. Vision in the sympathizing eye was reduced to 20/60—2, correctible to 20/30. Slit-lamp examination showed the anterior chamber of this eye filled with slowly moving cells and debris. Keratic precipitates and many vitreous opacities were present.

The exciting eye was enucleated the day after the patient was admitted to the eye center and was sent to the Army Medical Museum. A telegraphed pathologic report indicated that sympathetic ophthalmia was definitely present in this eye. The sympathetic eye was completely restored after the local and systemic use of penicillin and artificial fever therapy with the fever cabinet.

Investigation of the overseas record made it clear that the sympathetic ophthalmia had developed while the patient was en route to the Zone of Interior. The case illustrates the fact that when an eye was hopelessly lost, as the injured eye in this instance was, it was better to perform enucleation before the patient was started on a long chain of evacuation. It further illustrates the truth of the dogma that, in the absence of any cogent reason to the contrary, any eye which has sustained a penetrating wound should be enucleated within 3 weeks after injury unless posttraumatic inflammation has subsided or is well on the way to subsidence.

It is generally agreed that sympathetic ophthalmia develops in about 1 percent of all penetrating ocular injuries. The low incidence of the condition in the Army casualties of World War II is therefore extremely gratifying. The few patients in whom it did develop were treated with mydriatics; sodium salicylate; neoarsphenamine; diphtheria antitoxin; fever therapy; desensitization to uveal pigment; and sulfonamide therapy, which was effective in some cases.

CHAPTER XI

The Management of Intraocular Foreign Bodies in an Overseas Ophthalmic Center

George M. Haik, M. D.

While certain concepts concerning the management of intraocular foreign bodies developed during World War II, the ideas which emerged from that conflict represented, in large measure, a mass confirmation of the validity of practices in rather general use before the war. This confirmation, moreover, was based on a total experience which, in respect to the number and seriousness of the injuries treated, was never equaled in civilian practice and which far surpassed the comparable experience of World War I

In the Army, as in civilian practice, modern equipment and modern diagnostic and technical methods made it possible to remove a large proportion of intraocular foreign bodies and, frequently, to salvage a certain amount of vision. In some fortunate instances, the salvage amounted to useful vision. In a large number of cases, it amounted to little more than light perception or awareness of hand motion. In numerous instances, sight was irrevocably gone when the ophthalmologist first saw the patient. In military, as in civilian practice, the results were none too good. They were materially improved, however, by rather strict adherence to the routine of management to be described in this chapter.

GENERAL CONSIDERATIONS

Ophthalmic surgery in wartime is attended with many difficulties. There is no field of surgery which requires greater deliberation and greater delicacy, and few qualities are more difficult to achieve in the circumstances of war, even in rear areas. In forward areas, where the majority of injuries are sustained, attention must be concentrated first on saving life; other injuries, therefore, often take precedence over injuries of the eye.

Transportation to the rear in World War II was, for the most part, remarkably rapid, but it was necessarily dependent upon the exigencies of combat. There were often unavoidable delays, even in injuries in which good results depended in large measure on prompt, specialized treatment. Methods of transportation were often far from desirable. There was usually, even under the most favorable circumstances, a lapse of hours and sometimes of days before a casualty with an intraocular foreign body could be transported through the various echelons of the chain of evacuation to a general

hospital or to an eye center where specialized care was available. Ophthalmologists, very properly, were not attached to field or other forward hospitals. The low incidence of ophthalmic injuries would not have warranted such utilization of specialized personnel, and the environment was not propitious for complex, minute, tedious surgical maneuvers.

On the other hand, an intraocular foreign body is never a true emergency. Army ophthalmologists promptly learned, if they did not already know, the benefit which frequently attends making haste slowly. Competent removal of intraocular foreign bodies is dependent upon their accurate localization, and accurate localization takes time. Casualties with this type of injury were therefore not given definitive treatment until they reached an installation equipped and staffed for that purpose. That a foreign body will eventually become embedded in the tissues if it remains in the eye is obvious. How soon the process of embedding becomes dangerously tenacious is not yet clear. Army experience suggests that it is a matter of days, rather than of hours, before this occurs.

There was repeated proof of the wisdom of this sort of sensible delay. In one series of 17 patients with intraocular foreign bodies treated at the 64th General Hospital Ophthalmic Center, in all of whom removal of the particles was possible, there had been 15 previous unsuccessful attempts at removal in forward areas. Unquestionably, the reason for the first failures was that facilities for proper localization did not exist in forward installations.

Toward the end of the war, air evacuation had become generally available, and patients with intraocular foreign bodies could be given a relatively high priority in evacuation. It was then possible to give these casualties prompt treatment by competent personnel, in propitious surroundings. As a matter of fact, for a month in 1944, the 64th General Hospital Ophthalmic Center received casualties flown directly from the front. This hospital then operated at Leghorn, 12 miles from Pisa, which the Germans still occupied, and there were no field or evacuation hospitals ahead of it.

The chief difficulty in the management of intraocular foreign bodies, in military as in civilian practice, is the essential constitution of such bodies. Even before the outbreak of World War II, nonmagnetic materials were coming into more and more extensive use in industry. As the war progressed and aluminum and magnesium alloys were increasingly substituted for brass and steel, the incidence of nonmagnetic foreign bodies steadily increased. Magnet removal is, generally speaking, the simplest and most desirable method of managing foreign bodies, but as the war progressed, it became applicable to a smaller proportion of cases.

The military ophthalmologist also had other difficulties. Foreign bodies were likely to be multiple, which is not usual in civilian practice. Particles which entered the eye in combat frequently did so with great force and caused correspondingly great structural damage. The degree of explosive force, indeed, was more important than the size of the object. Objects which entered

the eye in battle were, however, often larger than the objects seen in civilian practice, and, although their size influenced prognosis, it was frequently not the deciding factor in the end result. It was sometimes necessary to enucleate eyes in which the particles were less than 1 mm. in length, but it was sometimes possible to save others in which the particles were as long as 14 to 16 mm.

Generally speaking, infection was not frequent in World War II even when patients with intraocular foreign bodies were not seen for several days after injury. Occasionally, cells were observed in the anterior chamber within an hour after the entrance of the foreign body, but devastating inflammatory reactions did not usually occur for at least 4 to 6 days, as the following case shows.

A patient was admitted to the 64th General Hospital Ophthalmic Center 6 days after his left eye had been injured by shell fragments. When he was seen at an evacuation hospital, soon after the injury, visual acuity was 20/30. The ophthalmologist was of the opinion that the soldier had suffered a double perforation of the globe and that the foreign body had entered a few millimeters from the limbus. The roentgenologist believed that the object was extraocular. Exact localization was not attempted.

For 5 days, the soldier's course was uneventful. The following day, however, a severe chemical endophthalmitis developed. The cornea became hazy, and there were numerous deposits on the posterior corneal surface. The iris was sickly green, and the aqueous was fixed.

As soon as the patient reached the 64th General Hospital, exact localization was carried out, and a metallic fragment 16 mm. in length was removed from the posterior vitreous chamber. Postoperative care included the use of atropine, sulfadiazine, and foreign protein therapy. Vision in the injured eye was 20/200 when the patient left the hospital.

INITIAL MANAGEMENT

While an ideal regimen for the management of ocular injuries was not always strictly carried out, chiefly because the tactical situation often did not permit it, the ideal was, in general, observed as closely as possible. The important phases of the preoperative routine included the following:

1. *First aid.*—The excellently trained company aidmen who transported the injured from the field of battle were instructed to administer no treatment for intraocular injuries other than simple first aid. They had been taught that all injuries involving the eye were potentially disastrous and that their share in averting a catastrophe was to get the injured man to a medical officer as promptly as the tactical situation permitted. They were forbidden to take active measures of any kind. Their task was limited to (1) covering the eye with a sterile pad after gently removing superficial dirt and debris; (2) instructing the patient to keep as quiet as he could and under no circumstances to

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touch his eyes; and (3) arranging for evacuation, preferably recumbent, as promptly as possible.

2. *Transportation.* Ideally, all soldiers with injuries of the eye were evacuated recumbent and remained recumbent, preferably on the litters on which they had first been placed, until the character and extent of the eye injury had been determined. This policy was sound. Intraocular hemorrhage and loss of vitreous, which are risks in all eye injuries, are greatly increased by voluntary movements and careless handling. However, because the circumstances of warfare frequently prevented achievement of the ideal, many eye casualties not disabled by other wounds were received sitting up or even walking.

DIAGNOSIS AND LOCALIZATION

History Taking

In civilian practice, the history of the injury of an eye is frequently useful. It provides data concerning the circumstances of the accident; the kind of foreign body; and, usually, its force, direction, and potentiality for infection. In battle injuries, the casualty often did not know the type of missile which had struck him, was sometimes not clear about the circumstances of wounding, and occasionally did not realize that his eye had been injured. Every military ophthalmologist had the experience of dealing with patients who became aware of their injuries for the first time when, as in the following case, the eye flared up into activity.

A patient was admitted to the 64th General Hospital Ophthalmic Center several months after treatment for wounds of the face, from which he had fully recovered, and 5 days after the development of an acute choroiditis of unknown etiology. Examination with the slit lamp revealed a small hole in the iris, and roentgenologic examination disclosed a foreign body in the retina. Removal of the object after localization resulted in almost immediate subsidence of the uveitis.

This case furnishes an excellent illustration of the importance of routine roentgenologic examination for demonstration of a possible foreign body in the eye in every instance of uveitis in soldiers who had been in combat. It is also an excellent illustration of the importance of excluding possible intraocular foreign bodies in all wounds in or about the eye.

General Examination

The patient in whom the presence of an intraocular foreign body was suspected was placed in a partially darkened room as soon as he was admitted to the hospital. He was cautioned to keep both eyes closed, as if he were asleep, and to make no movements until the character of his injury could be determined by examination.

Pontocaine Hydrochloride (0.5 percent) was instilled into both eyes before any investigation was undertaken. If the injury seemed serious and always when it was bilateral, local analgesia was secured with 4-percent cocaine solution, and adrenalin (1:1,000) was instilled into the eyes in 2-drop amounts 4 times at 4-minute intervals. Meantime, Pentothal Sodium (thiopental sodium) was administered intravenously, and no attempt at examination was made until the patient was fully relaxed. This type of anesthesia, which was achieved readily and the duration of which could be regulated as required, proved extremely useful in military ophthalmic practice. The patient was often nervous and apprehensive, and a successful investigation of the ocular injury could not have been carried out without some form of anesthesia. Since practically all the casualties were men in the prime of life, the fact that thiopental sodium is undesirable in young children and elderly persons seldom had to be considered.

Examination always included both eyes. In all serious injuries, it was a rather general practice to insert retraction sutures of fine black silk in the upper and lower lids. This did away with the necessity for specula and retractors,which add to existing trauma and the pressure of which contributes to the risk of loss of vitreous. Attempts to determine the presence of a perforating wound by pressure on the eyeball with the fingers or with a tonometer were avoided. If a wound was present, such maneuvers almost inevitably caused the loss of vitreous.

The routine of examination in the Army was much the same as in civilian practice. The investigation began with inspection under direct illumination, which often gave useful information if hemorrhage or inflammation did not obscure the field and if the fundus reflex was present. The examination was continued by means of the loupe, the ophthalmoscope, and the slit lamp.

It was never assumed, because the lids were closed by hemorrhage, edema, or both, that the injuries were confined to the lids. They were gently retracted, and intraocular foreign bodies were searched for, though it was sometimes necessary to delay the examination until compresses and other measures had reduced the edema and made manipulations possible without inflicting additional trauma. Military ophthalmology provided few more perplexing problems than delayed cases in which these changes had already obscured the intraocular field when the patient was first seen.

A visible laceration of the cornea or the sclera was regarded as presumptive evidence that a foreign body had entered the eye. If, however, a reliable history of injury could be secured, the absence of such a wound was never considered a contraindication to further investigation. A small wound was often imperceptible, particularly if the patient had not been seen until 24 hours or more after injury. If the patient had not been seen promptly, a thin, small metallic fragment frequently left no gross evidence of its entrance. When the ophthalmologists of the 64th General Hospital Ophthalmic Center worked close to the forward lines or when patients were evacuated to the hospital by

air, the wound of entrance was usually still visible. As the line moved forward or when patients were not seen until 24 hours or more after injury, the wound of entrance was frequently sealed and could not be demonstrated by any method of examination except roentgenography.

Prolapse of any portion of the uveal track or of the vitreous or the presence of a shallow deformity of the anterior chamber was regarded as prima facie evidence of a perforating wound caused by a possible intraocular foreign body.

Special measures. The use of a magnet for diagnostic purposes was discouraged. If the object was nonmagnetic, the procedure was a waste of time. If it was magnetic, even slight movements under noncontrolled conditions could be harmful. Negative findings, moreover, could not be taken at their face value. The possibility always existed that the object was too small or lay at too great a distance from the magnet to be attracted by it, or was too deeply embedded in the tissues to give rise to a sense of pain on movement. If the magnet was ever used for diagnostic purposes, it was always as a last resort, after all other investigations had been unsuccessful and with full realization of the possible risks entailed.

Stallard's [1] suggestion that fragments of foreign bodies embedded elsewhere in the body be removed and examined roentgenologically to determine their constituents was not regarded by American ophthalmologists as particularly useful in the management of intraocular foreign bodies, for several reasons. Explosives were often made up of several kinds of material. Some detonators, for example, as well as grenades and mines, consisted of 90 percent nonmagnetic and 10 percent magnetic material. It was therefore quite possible that one variety might be in the eye and another variety elsewhere in the body. Furthermore, all foreign bodies in the same patient were not necessarily of the same origin.

Roentgenologic Examination and Localization

Military ophthalmologic experience fully confirmed the value of roentgenologic localization of intraocular foreign bodies. It also proved that, unless the procedure is performed by specialized personnel versed in refined techniques and interested in results, the examination is useless and can be misleading. The eye is so small that an error in localization of as little as 1 or 2 mm. may mean a misplaced incision and unnecessary trauma, if not actual failure of an operation. The best results were always achieved when localization of intraocular foreign bodies was a cooperative procedure and when a member of the ophthalmologic staff was present throughout the entire roentgenologic examination.

Part of the success of localization of intraocular foreign bodies during World War II depended upon numerous small precautions. At the 64th General Hospital Ophthalmic Center, the same technicians, all of whom had been carefully trained, were always assigned to this work. The members of

[1] Stallard, H. B.: War Surgery of the Eye. An Analysis of 102 Cases of Intraocular Foreign Bodies. Brit. J. Ophth. 28: 105-135, March 1944.

this group were extremely competent. They knew that roentgenograms must be retaken and localization recomputed if the findings of all methods of examination did not check with each other. The cassettes used for eye work were kept scrupulously clean and were used for no other purpose. No distracting movements or noises were permitted in the examining room. The procedure to be carried out was explained to the patient, and the importance of his cooperation was stressed. Films were checked while he was still in the X-ray department and were repeated at once if there was any doubt concerning their clarity.

Roentgenologic examination in all cases of suspected foreign bodies began with a posteroanterior view of the skull (fig. 32), followed by a lateral view



FIGURE 32.—Posteroanterior roentgenogram, Waters position. Foreign body in vitreous. Localization by contact lens, lead-bead markers, and ring method.

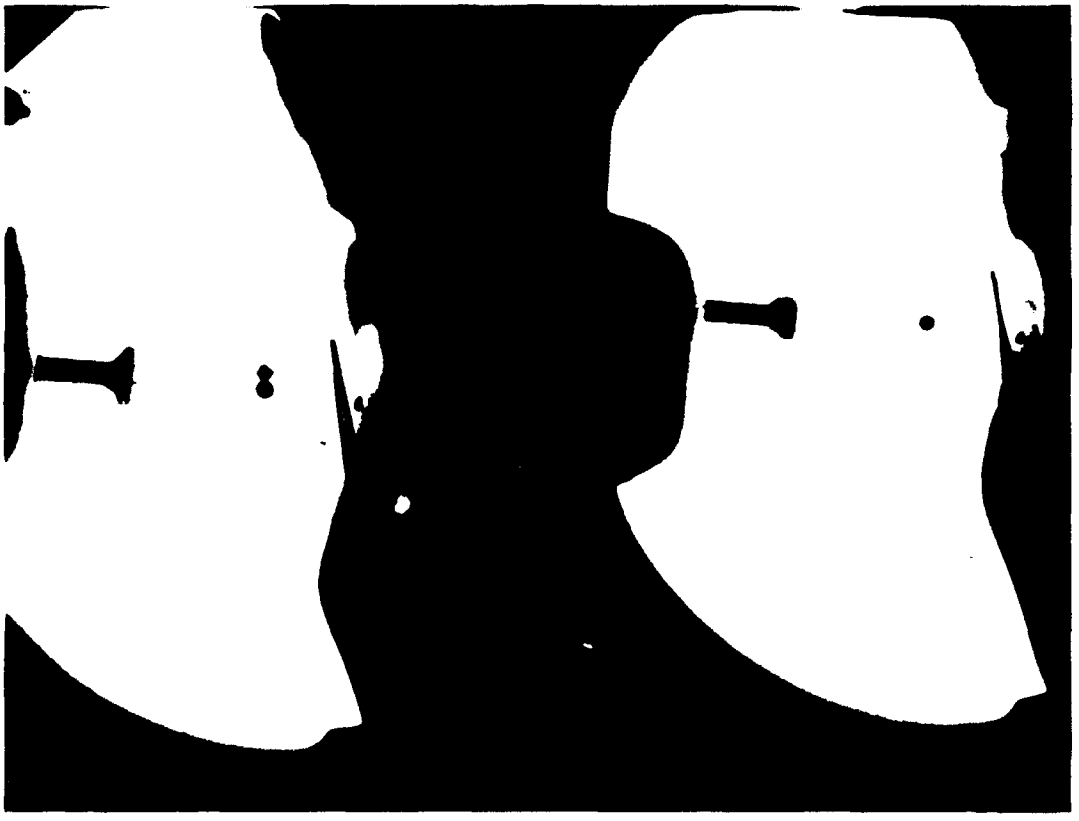


FIGURE 33. Lateral roentgenogram. Foreign body in vitreous. Localization by ring method, with lead-bead markers, and Sweet method.

(fig. 33), to determine the presence of the foreign body and its size, shape, and approximate position. The error which can arise from movements of the eye was eliminated in posteroanterior films by having the patient direct the gaze of the uninjured eye into an angled mirror at an object located laterally to him. In lateral films, the gaze was directed at some object straight ahead. Use of the Waters position (figs. 32 and 34) was helpful in eliminating the confusing shadow of the petrous bone.

Special Localizing Roentgenologic Methods

The accuracy of roentgenologic localization of foreign bodies was always improved when supplemental methods were employed and the results were checked against each other (figs. 32 through 35).

The double-exposure method was one of the most useful techniques. A silver ring, from 22 to 26 mm. in diameter, was slipped into the cul-de-sac after local analgesia had been achieved with Pontocaine Hydrochloride. Two double exposures were taken—one with the patient looking first upward and then downward; the second, taken on another film, with the patient looking



FIGURE 34. Posteroanterior roentgenogram, Waters position. Foreign body in sclera. Localization by ring method. A. Patient is looking up. B. Patient is looking down.

first to the right and then to the left. As each exposure was taken, the lids were held open either manually or with traction sutures.

Several errors had to be guarded against when the double-exposure method was used. One of the most important was the risk of overlooking a foreign body of minute size which might not show up because the film had been made with only half the exposure ordinarily employed. Repeated films of varying densities were helpful in such cases. Another possible error was the diagnosis of the foreign body as intraocular when actually it was lodged in muscles, orbit, or fat, or in Tenon's capsule. Bone shadows were often troublesome when minute foreign bodies were in the anterior segment of the eye. In such cases, it was frequently useful to insert a dental film at the inner canthus,

between the globe and the lower lid and take the pictures from various angles. If the foreign body had perforated the globe and lay just outside the sclera, the injection of air or oxygen into Tenon's capsule before the picture was taken usually clarified the situation.

Another useful aid to localization was to suture 4 small lead beads in 4 different positions about the limbus before roentgenograms were taken.



FIGURE 35 Lateral roentgenogram. Foreign body in lower vitreous. [illegible] Sweet method.

Even if the patient moved, the relationship of the location of the body to the beads remained the same.

Many ophthalmologists considered this method more accurate than the use of a contact lens, as in the Comberg method. The introduction of the lens causes additional trauma, and the lens at best fits only approxi since eyeballs differ materially in size and curvature and estimates of of error are only approximate. Some of these objections could probably be overcome by the use of the acrylic localizing shell devised by Thorpe. This

[illegible]

shell was designed to be anchored to the episclera with silk sutures, making shifting impossible. However, this device was not available at all eye centers.

Whether the ring or the bead method of localization was used, stereoscopy was found to be of great value in the management of intraocular foreign bodies encountered in military practice.

The Sweet method of localization (figs. 33 and 35) was used almost exclusively at the eye center at the 64th General Hospital. It proved useful and practical under the difficult circumstances which frequently prevailed. It is still generally regarded as the most accurate means of localization available. The coordinates and master charts available have eliminated much of the tedious calculation formerly necessary, and with them results can be secured within 10 or 15 minutes, an important consideration when time is precious and specialized personnel in short supply. Localization obtained by this method was checked against the position apparent in the posteroanterior roentgenogram.

Locators

Minsky,[3] in tracing the history of the localization of intraocular foreign bodies, pointed out that Aveling, in 1851, was the first to attempt utilization of the principles of magnetism to locate steel in the body and Pooley, in 1880, the first to apply them to the localization of foreign bodies in the eye.

The Berman locator, which had been used with so much success at Pearl Harbor, was subsequently adapted to identification of foreign bodies within the eye and was used successfully in many eye centers in the Zone of Interior. It was not available to any installation in the Mediterranean Theater of Operations. In that theater, toward the close of the war, there came into use an extremely efficient locator devised by Lt. Col. Henry Carney of the Army Dental Corps. The first instrument which was made from a wornout mine detector and powered by flashlight batteries and a B-battery, all items which could be secured without difficulty, was intended for the identification of foreign bodies elsewhere in the body. Shortly before the close of hostilities in the Mediterranean theater, it was modified for use in the eye and proved extremely efficient. Like the Berman locator, it indicates, by changes on the dial or in the pitch of a built-in loud speaker as it passes over the tissues, the location of the magnetic object and, therefore, the point at which the incision is to be made. As the incision is deepened, the element, which may be sterilized, can be introduced more deeply, so that precise localization is possible throughout the whole procedure of extraction. Reapplication of the locator after a foreign body is removed will disclose whether additional particles are present. Like the Berman locator, the Carney locator does not indicate the location of nonmagnetic foreign bodies.

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[3] Minsky, H.: Transscleral Removal of Intraocular Foreign Body With the Aid of the Berman Locator. Arch. Ophth. 31: 207-210, March 1944.

GENERAL PRINCIPLES OF MANAGEMENT

In military as well as in civilian practice, the removal of an intraocular foreign body was theoretically always desirable. Whether or not its removal was practical was another matter. Whether or not removal, if practical, was the part of wisdom was still another matter. The extraction of a foreign body which is anything but superficial is always attended with a certain, usually calculable, degree of risk. The Army ophthalmic surgeon had to determine (1) whether the amount of trauma involved in removal of the foreign body would be so great that it would not be justified; (2) whether the object could be left in the eye with the expectation that it would not give rise to trouble in the future; (3) whether the eye was already so damaged that immediate enucleation would be the conservative choice; or (4) whether extraction of the object should be proceeded with at once.

Before the outbreak of World War II, it had been clearly established that the toxicity of foreign bodies for ocular tissues varies according to their composition. Gold, silver, and platinum, which are not often found in the eye and which furnished no military problems, are usually well tolerated. Iron (especially soft iron) and copper oxidize rapidly and usually give rise to siderosis bulbi or chalcosis. Lead and zinc are moderately irritating. Glass, aluminum, and certain of the new plastics are apparently inert. The military ophthalmologist could be guided by these general considerations, but he also had to bear in mind the fact that even inert materials may eventually give rise to trouble. Even before the war, the literature was full of case reports which demonstrated that fact, and the optimistic concept that presumably inert foreign bodies can be left in the eye without risk proved to have no sounder basis in military practice than it has in civilian practice, though it does not follow that acceptance of the risk was not sometimes wiser than attempted extraction of the objects.

It was fairly routine military practice to explore an injured eye in the region of the injury when double-exposure roentgenograms revealed a foreign body as apparently moving. Whenever the results of the examination were inconclusive and it was believed that the calculated risk of operation was less than the risk of permitting a suspected intraocular foreign body to remain in the eye, exploration was also carried out. Finally, it was the practice to explore the eye in any case in which there was reason to doubt a negative roentgenologic report, as well as in any case in which accurate localization was not successful, particularly if the foreign body was located 2 to 3 mm. from the sclera.

Removal was practically always attempted if the foreign body was magnetic. If it was not, the course of action depended upon the circumstances of the special case. If the object lay close to the anterior segment and was readily accessible, removal was usually undertaken. Otherwise, it was the

practice to let relatively harmless particles, such as plastics or glass, remain in situ. The exception to this rule was a foreign body in the lens. Early in the war, the concept, derived from civilian experience, was rather generally entertained that, if the eye was quiet, observation would be safe. It was soon learned that, regardless of the composition of the foreign body, the inflammatory reaction which it might excite was more severe in the lens than in any other part of the eye. Furthermore, even if delayed extraction was successful, the eye was almost invariably lost. This course of events was in contrast to that in other areas of the eye in which, even if an acute endophthalmitis developed, removal of the object usually saved the eye, often with some remaining useful vision.

Primary Enucleation

Enucleation of the damaged eye when the patient was usually no more warranted in military ophthalmology than it is in civilian practice, unless the eye was indubitably destroyed. At first inspection, it was often impossible to evaluate the situation, particularly if intraocular hemorrhage had occurred, and delay to allow determination of the exact status of the eye was attended with only minimal risk because of the protection afforded by chemotherapy and antibiotic therapy. When the injury was bilateral, it was particularly important to delay radical surgery because sometimes the eye which at first seemed in the poorer condition later proved to have the better vision.

The presence of or development of chemical endophthalmitis, even if severe, was also not regarded as an indication for immediate enucleation if the foreign body could be removed. In numerous cases of this kind, the infection was controlled by foreign protein and other therapy, and at least partial vision was preserved.

Sympathetic ophthalmia.—The facts concerning sympathetic ophthalmia were fairly well clarified before World War II. Military experience removed whatever excuse might once have existed for panic enucleation of an injured eye. Most ophthalmologists, indeed, did not see a single instance of the condition during the war.

All ophthalmologic experience is to the effect that sympathetic ophthalmia does not occur until at least 3 weeks have elapsed after injury. It was Army practice, therefore, just as it has long been the practice of most civilian ophthalmologists, to defer enucleation, in the absence of absolute indications, until the injury could be carefully surveyed and a deliberate decision made about its management, with 14 to 21 days after wounding as the upper limit of permissible delay. As a matter of fact, indications were usually clear considerably earlier if the operation proved necessary. The small number of cases of sympathetic ophthalmia observed in World War II is proof of the safety of this policy.

Delayed Enucleation

In some instances, several attempts to remove the foreign body failed, but, unless the eye became painful and soft or light perception was permanently lost, enucleation was still delayed. In one such case, resulting from the explosion of a 37-mm. gun, three attempts were unsuccessful to remove a fragment (probably of aluminum) from the vitreous. A fourth attempt, made after the patient arrived in the Zone of Interior, also failed. Exploration was carried out through both the anterior and the posterior routes. The eye remained quiet, however, and good vision was maintained. When this soldier was first seen, other, more superficial, fragments were removed without difficulty from both eyes; some were magnetic and others nonmagnetic. Roentgenologic examination was negative in this case, the intraocular foreign body being observed only by ophthalmoscopy.

OPERATION

Anesthesia.—Local analgesia was not desirable in military ophthalmology. The patients were frequently physically exhausted and in a state of nervous tension, and their condition, coupled with the fact that inflammation was often present, made complete anesthesia preferable. Pentothal Sodium anesthesia, supplemented with local analgesia, proved an ideal combination. It permitted maximum relaxation, and it was seldom necessary to section a muscle to expose the posterior sclera, which was often necessary when only local analgesia was used.

Preparation of field.—After the eyelashes had been clipped, the face was thoroughly washed with white soap and water, great care being taken to avoid pressure on the eyelids and eyeballs. The face was then wiped with 70 percent alcohol followed by the application of tincture of Merthiolate. Finally, Argyrol in 10-percent solution was instilled into the eyes and was removed with copious irrigations of warm boric acid solution. The usual drapings were then put in place.

Technical Considerations

Route of approach.—During the war, the technique of removal of intraocular foreign bodies, particularly of nonmagnetic bodies, underwent a considerable change in that the posterior route became increasingly popular. Although some ophthalmologists continued to regard this approach as completely unjustified, others no longer used the anterior route under any circumstances. However, with the single and very important exception of the removal of foreign objects from the ciliary body, it was the general consensus that the wisest plan was to approach the object on the basis of its location. As in civilian practice, every route had its attendant advantages and disadvantages. It was clearly unwise to apply a magnet and draw a large mag-

netic particle into the anterior chamber, with the risk of injuring the lens and iris and the additional risk of encapsulation of the object in the ciliary body. Incision of the sclera, uvea, or retina introduced the risk of hemorrhage and of detachment of the retina - either of which almost always led to permanently poor results. In military ophthalmology, individualization of cases was even more important than in civilian practice because the multiplicity of particles and their frequently explosive character often made their removal an extremely difficult procedure, especially under the circumstances of war.

Removal of a foreign body through the wound of entrance was sometimes possible, especially if the patient was seen early, though some enlargement of the wound was usually necessary. As a rule, however, an incision of election seemed the wiser approach, if for no other reason than that it could frequently be made nearer the object. It was soon learned that an important precaution, usually overlooked in civilian ophthalmology, was closure of the wound of entrance by diathermy. Failure to observe this precaution was the greatest single cause of retinal detachment in perforating injuries.

Techniques of removal.—The technique of the removal of intraocular foreign bodies in World War II can be summarized as follows:

1. A foreign body in the anterior chamber was removed with the small hand magnet. If it lay on the lens, atropine was first instilled to dilate the pupil and pull the iris away from the object. If it lay on the iris, eserine was first instilled to contract the pupil and loosen the object from the iritic meshwork. If the object was firmly enmeshed, or if the iris was excessively traumatized during the manipulations, it was sometimes necessary to excise a small portion of the iris along with the object. The chamber was restored with physiologic salt solution, and the keratome incision was closed with atraumatic silk sutures to prevent postoperative prolapse of the iris.

2. A foreign body penetrating the lens and lying in it was also removed by direct application of the magnet through a keratome incision.

3. A foreign body which had perforated the lens was removed through a posterior sclerotomy incision, because of the danger of loss of vitreous if an attempt were made to bring the object out through a wound in or around the lens. The traumatic cataract which inevitably resulted from complete perforation of the lens was corrected at a second operation. Removal of the lens at the same time as removal of the foreign body introduced the serious risk that the foreign body would slip farther back into the eye and perhaps be lost entirely.

4. A foreign body lying in the ciliary body, in military as in civilian injuries a danger zone, was removed through the pars plana, which lies between 7 and 10 mm. posterior to the limbus. The anterior approach was used if the object was more accessible anteriorly.

5. A foreign body lying in the posterior vitreous was removed by the posterior route, the incision being made directly over it, except, as already noted, when it lay in the region of the ciliary body. Dragging a foreign body through the pars plana across the vitreous is an invitation to retinal detachment

because of the adjacent fibrinous adhesions attaching the object to the retina.

6. A foreign body lying in the head of the optic nerve was often quite difficult to remove because it was likely to be fixed in fibrous tissue. It was found that the best plan was to make an incision a few millimeters anterior to the nerve head, using great caution to avoid injuring important structures. The magnet was then applied over the incision, with the force directed anteriorly. If this maneuver failed, the magnet was withdrawn, and a probe was passed through the wound in the direction of the nerve head. The magnet was then applied to the probe and, after a few seconds' delay to permit the object to become loosened from the nerve tissue, the probe was slowly withdrawn. A few drops of vitreous might be lost during the procedure, but the loss was nothing in comparison with the risk of permitting the object to remain in the nerve.

Management of the vitreous.—When a foreign body had been in the eye for any length of time, the vitreous was likely to be fluid, and great care was necessary to prevent a large loss when the sclera was incised. Frequently, even when the vitreous was of normal consistency, it bulged into the wound. If this happened, the bulging portion was clipped off with scissors before the sutures, which had been previously placed, brought the cut edges of the sclera together.

Application of the magnet.—The small hand magnet was standard equipment at all Army general hospitals and was the only type available at evacuation hospitals. It was preferred to the large magnet for the usual reasons, the chief one being that it is less awkward to manipulate. If an attempt to remove a foreign body with the small magnet was not successful, the large magnet was applied when it was available. In a fair number of instances, success was achieved with the large magnet when attempted extraction with the smaller instrument had failed. It should be emphasized that the difference between the magnets is not an increased magnetic attraction of the larger instrument but the increased size of the magnetic field. Regardless of which was used, varying the distance between the eye and the tip of the magnet controlled the degree of pull. Probes, forceps, and other instruments were never introduced into the vitreous to increase magnetism until more conservative methods had failed.

The usual rules for the introduction of a magnet into the eye were carefully followed in military practice. Ideally, the tip was applied directly to the foreign body or at a distance of not more than 2 mm. Application was always cautious. The magnet was not introduced into the wound until the location and size of the foreign body had been determined as accurately as possible and until the technique of extraction had been decided upon. It was never brought to the eye alive, and it was introduced into the wound as near the foreign body as possible before current was turned on.

Patient, repeated applications often achieved success in the most unpromising cases. Reports of the successful outcome of such persistence are

not infrequent in the literature. Wright and Duncan [4] reported two such instances. In the first, 6/6 vision was preserved in a German prisoner after 35 applications of the magnet. In the second instance, 6/9 vision was preserved in a British soldier after 75 applications, totaling 10 minutes and ranging in duration from 4 to 15 seconds in the course of 4 operations.

Management of Nonmagnetic Foreign Bodies

As has already been pointed out, nonmagnetic foreign bodies composed of presumably inert materials and lying in difficult or inaccessible locations were usually left alone, the patient being kept under observation. There was seldom any difficulty in extracting a foreign body from the anterior chamber through a keratome incision with blunt Arruga forceps. A foreign body penetrating the lens and lying within it was similarly removed or was removed with the aid of the cataract knife. A foreign body in the vitreous, if the lens was clear and visualization with the ophthalmoscope was possible, could be removed with forceps through a sclerotomy incision. The ocular endoscope devised by Thorpe would probably have been of great value for foreign bodies in this location, but, as has already been noted, it was not available in the Mediterranean theater.

Biplane fluoroscopy was used in a number of cases of nonmagnetic intraocular foreign bodies but did not prove useful. Small objects were obscured by bony structures, while those large enough to be visualized by this means had usually caused so much damage to the ocular structures that enucleation was necessary.

ADJUNCT THERAPY

Chemotherapy and antibiotic therapy.—The introduction of chemotherapeutic and antibiotic agents is one of the reasons why during World War II it was possible to delay the removal of intraocular foreign bodies without fear of the development of serious infection. Sulfanilamide and its derivatives, which were used early in the war, were generally replaced by penicillin after it became available in the spring of 1944, though a sulfonamide was sometimes used also. Eventually it became standard practice to administer penicillin in doses of 40,000 to 50,000 Oxford units in the field or evacuation hospital and to continue the administration until 2,500,000 units had been given. The local route was not employed unless infection in the anterior portion of the eye was suspected. In military practice as in civilian practice, infection was found to be most likely to occur when the wound of entrance was through the cornea and least likely when it was through the sclera. The vitreous, as always, proved a poor culture medium. Postoperative infections were usually inconsequential.

[4] Wright, R. E., and Duncan, H. A. G.: Experiences With the Giant Magnet and Metallic Intraocular Foreign Bodies in Recent Battle Casualties. Brit. M. J. 2: 658-659, 18 Nov. 1944.

Foreign protein therapy.—Foreign protein therapy, which was widely used in civilian ophthalmology before World War II, proved an extremely useful measure in military practice in all perforating wounds of the eye. In some hospitals, it was the custom to institute it as soon as a casualty with this type of wound reached the installation. Typhoid vaccine, however, was not widely used. It was never employed when the patient was first seen, since a casualty in shock or on the verge of it, or otherwise in poor condition, might be seriously harmed by a severe reaction. For practical reasons, it was seldom used after operation. A patient thus treated requires special nursing, which could not be supplied in an active theater of operations. Extremely good results were secured with injections of milk. In North Africa and Italy, where fresh milk could not be secured, canned milk proved a safe and effective substitute.

POSTOPERATIVE ROUTINE

At the conclusion of the operation, atropine sulfate (5-percent solution) was instilled into the eye, followed by powdered sulfanilamide and 5 percent boric acid. A binocular bandage was applied; it was found impossible to keep the injured eye at rest if only a monocular bandage was used. After 2 weeks, the bandage was removed, and a pinpoint shield was used on the injured eye.

The patient was warned against abrupt and violent movements during his convalescence. He was kept in bed from 2 to 4 weeks, and nursing supervision was such that inactivity was enforced.

In general, postoperative management was the same as in civilian practice except for the use of atropine sulfate solution in 5-percent instead of the usual 1-percent strength. This was necessary because of the difficulty of securing good dilatation of the pupil in young men, the majority of whom have strong sphincters.

SUMMARY AND CONCLUSIONS

The military ophthalmologic experience in an overseas theater in World War II seems to justify the following conclusions:

1. Although the management of intraocular foreign bodies rests upon certain basic principles, the management of every case is an individual problem.

2. An intraocular foreign body is always serious, the gravity of the injury depending upon its location. It does not constitute a true emergency in the sense that immediate extraction is necessary.

3. Pinpoint localization of the foreign body is far more essential than speed of extraction. Extraction is, in fact, facilitated by allowing sufficient time for precise roentgenologic localization, supplemented by the use of the Berman or Carney locator.

4. The technique of extraction must be related to the composition and location of the foreign body and the condition of the eye. Removal by mag-

net is preferable to any other method, but purely surgical methods are necessary if the object is nonmagnetic. The procedure must be carefully planned before any step is undertaken. Whether extraction of a nonmagnetic foreign body should be attempted depends upon the location of the object and its composition.

5. sympathetic ophthalmia is a remote and calculable, not an immediate, danger. Emergency enucleation is therefore seldom justified.

6. Chemotherapy and antibiotic therapy should be used routinely in all perforating wounds. Foreign protein therapy is also of great value.

7. Military practices concerning transportation of the injured, first-aid methods, and certain other matters could profitably be transferred to civilian ophthalmology.

8. Since, at best, the results of treatment of intraocular foreign bodies are not outstanding, no precaution should be overlooked that can improve them.

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CHAPTER XII

Uveitis in Zone of Interior Hospitals

Donald E. Swift, M. D.

Although uveitis was responsible for only a small proportion of hospital admissions during World War II, it represented a not inconsiderable proportion of all cases of ocular disability, and it was responsible for a loss of manpower days out of all proportion to its seriousness as a disease. During the period, for instance, during which O'Reilly General Hospital was in active operation, approximately 3,000 patients were admitted to the eye service, of whom approximately 13 percent suffered from this condition. The response to treatment was frequently discouragingly slow, and recurrence could be expected in 8 to 10 percent of all cases. The average duration of hospitalization was 60 days, and only 50 percent of the patients could be returned to duty at the end of that time. The remainder were released from Army service and were returned to civilian life or referred to a veterans' hospital for further treatment.

The experience of O'Reilly General Hospital was typical in respect to the time at which patients with uveitis were seen. Eighteen percent were seen early in their first attack of acute disease. Seventy-four percent had received more or less intensive treatment elsewhere before being transferred to this hospital while it was serving as an eye center. Their disease had lasted, on the average, from 2 to 4 months and was classified as chronic. The remaining 8 percent of the patients were admitted to the hospital with recurrences. Of the 400 cases treated at this hospital during its entire period of operation, 250 were idiopathic in type, and 150 were of traumatic origin.

ETIOLOGY

The underlying causes of uveitis proved as difficult to identify in Army experience as they are in civilian practice. One hundred consecutive cases of active idiopathic uveitis were intensively studied, from this standpoint, at O'Reilly General Hospital, but in only seventy-one, something over two-thirds, was it possible to determine even probable etiologic factors. All varieties of the disease, acute, chronic, and recurrent, were represented in this group. Four patients had iridocyclitis only. Two had iridocyclitis with an area of chorioretinitis in the affected eye. In the remaining patients, either the area of chorioretinitis was evident, or vitreous exudate was so

extensive that none of the details of the fundus could be made out. Secondary glaucoma was present in two of the patients whose uveitis was so severe that the fundus could not be seen, and retinal detachment had occurred in three patients with chorioretinitis.

In 29 of the 100 cases studied from the etiologic standpoint, no causative factors, as already mentioned, could be identified. In the remaining 71 cases, 1 possible factor was identified in 28, 2 factors in 31, 3 factors in 10, and 4 factors in 2.

The most frequent probable etiologic factor identified in this survey was some focus of infection. In this group of patients, 36 had infected tonsils; 35, infected teeth; 11, prostatitis; and 9, disease of the sinuses. There was considerable overlapping. Several patients presented more than one focus of infection, and several with foci of infection also presented other possible etiologic factors.

Of the 100 patients, 26 showed a sensitivity to tuberculin, and 12 in this group presented roentgenologic evidence of healed primary pulmonary tuberculosis. In three cases, roentgenograms of the chest were not available for examination, but pulmonary tuberculosis was not mentioned in the routine roentgenologic reports attached to the service record. In the remaining cases, roentgenograms of the chest were negative. Of the 26 patients who showed sensitivity to tuberculin, 6 presented no other possible etiologic factors, but 20 presented one or more other conditions.

Four patients, all of whom presented one or more other etiologic factors, had syphilis. An allergic diathesis was present in four patients, but other factors were present in two of these cases, and it was the opinion of the consultant in allergy that the allergic condition was not the basis of the uveitis in any instance. Two patients had rheumatoid arthritis; in one, chorioretinitis was present and in the other, iridocyclitis. Both had foci of infection. Agglutination tests for *Brucella melitensis* were positive in two cases, in neither of which were there any present or previous signs or symptoms of brucellosis. In two cases, uveitis appeared during or followed an acute infection of the upper respiratory tract.

Certain factors which may be responsible for uveitis were not apparent in this survey (or in any other case studied at the O'Reilly General Hospital Eye Center). Neither gonorrhea nor toxoplasmosis was identified. There was also no evidence of sarcoid in any patient at the time of the survey, though at a later date one patient was found to have roentgenologic changes in the lung fields typical of Boeck's sarcoid. In this case, at the time of the survey, two of the keratic precipitates were unusually large, and keratitis was apparently marked since several deep, newly formed vessels were observed. Details of the fundus could not be made out.

The results of this intensive search for etiologic factors in 100 cases of uveitis parallel the results obtained in similar civilian studies. They may be assumed to be significant. Except that no metabolic studies were made and

that tests for possible allergies were not always complete, this study was made under the most favorable conditions imaginable, conditions which are seldom duplicated in civilian life. The patients, because they were under Army discipline, could be strictly controlled. With the exceptions noted, identical tests were carried out in all. Full cooperation and assistance were received from the laboratory, from the roentgenologic and dental departments, and from consultants in internal medicine, allergy, otolaryngology, urology, and other specialties.

In spite of these favorable conditions, however, no etiologic factor could be identified in 29 of the 100 cases. Moreover, the mere finding of possible etiologic factors in any case of uveitis does not necessarily prove that these factors are the basic cause of the condition. Conclusions must be based on circumstantial evidence, which is less convincing as the number of possible etiologic factors multiplies in any given case.

In this survey, as in most previous surveys, foci of infection, with tonsillar and dental infections predominating, were the most frequent possible causes. Investigators in this field have expressed the opinion that when a focus (foci) of infection is responsible for uveitis, the ocular tissues have become sensitized by the presence of or the repeated presence of toxins in the blood stream, so that any increase in the amount of toxins reaching the uveal tract can cause an inflammatory reaction. The weak link in the argument is, of course, the fact that in most patients with foci of infection uveitis does not develop. This failure is explained by the fact that each individual's sensitivity to certain organisms varies with his ability to form immune bodies to neutralize the toxins and to form phagocytes to destroy bacteria. It is an accepted fact that there exists a delicate balance between the host's ability to neutralize or destroy infective organisms and their products and the presence and development of the organisms and their toxins. Immunity is greatly reduced following debilitating diseases or in fatigue and similar states. It therefore seems reasonable to assume that the rigors of military duty may have been responsible for the fact that an individual who was perfectly healthy in civilian life should develop uveitis, as the result of foci of infection, after more or less long periods of military life.

Traumatic uveitis. The etiology of traumatic uveitis of course presented no problems. It was obviously the result of previous trauma. Many patients in this group seen at the various eye centers had only mild disease, but their eyes had been seriously damaged as the result of double penetrating wounds or retained intraocular foreign bodies. Correlation between the seriousness of the injury and the severity of the subsequent uveitis was inconstant.

DIAGNOSTIC ROUTINE

Regardless of the cause of the condition, a routine diagnostic survey of each patient was carried out, since it was always possible that additional factors

might be active in cases of trauma. The survey routine consisted of the following procedures:

1. A complete history and physical examination;

2. A thorough search for foci of infection, with the aid of consultants in otolaryngology, urology, and dentistry;

3. Roentgenologic examination of the chest and of the teeth, examination of the teeth always including the roots;

4. Urinalysis; complete blood study; serologic testing (Kahn) for syphilis; agglutination tests for *Br. melitensis*, by the use of serial dilutions from 1 : 20 to 1 : 2,560;

5. Intradermal tuberculin tests using purified protein derivative, with interpretations of sensitivity made at the end of 24 and 48 hours;

6. Additional laboratory tests, such as spinal-fluid examination, blood chemistry, renal-function determinations, and basal-metabolic-rate determinations according to the indications in the special case;

7. Tests for allergy according to the indications in the special case; and

8. A complete ophthalmologic study.

It was always useful in the diagnostic survey to discover signs regarded as distinctive, or even pathognomonic, of special etiologic factors. Keratic precipitates of the mutton-fat type, for instance, and Koeppe nodules on the pupillary border of the iris point to tuberculous iridocyclitis. Stigmata of congenital syphilis or healed lesions of acquired syphilitic disease point to a syphilitic origin. These and similar findings were duly evaluated, but the complete survey of the patient was not limited by the discovery of these or any other signs. The frequency of multiple possible etiologic factors in all surveys of uveitis indicates the importance of completing a diagnostic survey, regardless of the initial findings.

THERAPY

Routine Therapy

All patients with uveitis were given sulfadiazine by mouth, in doses of 2 gm. initially, followed by 1 gm. every 4 hours, for 2 to 4 weeks. Blood levels between 5 and 10 mg. percent could usually be attained and maintained by administration of the drug in these amounts. Other sulfonamides were occasionally used, but it was generally thought that sulfadiazine was preferable because of its lesser toxicity. When penicillin became available, the routine was developed of giving each patient with uveitis 20,000 units intramuscularly every 3 hours, usually for 5 days. It was the general opinion that chemotherapy and antibiotic therapy were not usually useful in uveitis. In an occasional acute case, the course of the disease was possibly shortened, and, if the disease was of syphilitic origin, results with penicillin therapy were sometimes dramatic. Treatment in this type of case was usually carried out by the consultant in medicine or on the medical service.

It should be added, in connection with the use of chemotherapeutic and antibiotic measures, that their evaluation as independent modalities was difficult because they were always used in connection with other measures. On the other hand, experienced physicians, familiar with the results which usually occur following the use of other measures, were in a position to evaluate fairly the results which were achieved when a sulfonamide or penicillin was added to them. It should also be added that the majority of patients with uveitis who reached the eye centers had already had full courses of penicillin in other installations in the Zone of Interior or overseas.

When patients with uveitis were first seen, the eye was placed at rest and an attempt was made to prevent the formation of posterior synechiae by instillations of a solution of 1 percent atropine. Instillations were made with sufficient frequency to insure maximum dilatation of the pupil. Hot compresses were used routinely. If synechiae were present, an attempt was sometimes made to rupture them by instillation of Neo-Synephrine Hydrochloride (phenylephrine hydrochloride) in 10 percent solution.

Nicotinic acid was used for its vasodilating properties, usually in 50-mg. doses, by mouth, 3 times daily. Vitamin therapy was employed according to the indications.

Foci of infection which had been identified were eliminated, according to the indications of the special case, by tonsillectomy, extraction of teeth, treatment of prostatitis, treatment of sinus disease, and similar measures. It was difficult, in most cases to attribute improvement to these specific procedures, though occasionally notable improvement followed tonsillectomy or the extraction of teeth.

Patients with rheumatoid arthritis were given maximum doses of salicylates, usually for 3 weeks. The medication was extremely useful in controlling pain and discomfort in the extremities but had no evident effect on the uveal disease. Salicylates were tentatively administered in a few cases of uveitis not associated with arthritis but were also without effect.

Special Measures

Foreign protein therapy.—Nonspecific protein therapy was used, sometimes in the form of intramuscular injections of boiled milk but more often in the form of intravenous injections of typhoid vaccine. While application of the method varied from installation to installation, as a rule five doses were given on alternate days. The initial dose, which consisted of 30 million organisms, was progressively increased until the fifth and final dose consisted of 200 million organisms or more. A temperature of 102° F. was regarded as satisfactory. Experience has shown that the vasodilator effect of therapy is satisfactory when this elevation is reached and that the stimulation of antibody formation in the system is also adequate.

When response to the initial series of typhoid injections was slight, a

second or even a third course was given. Occasionally, when no reaction or no satisfactory reaction had been achieved by the fifth injection of the first series, a sixth injection of 300 million or even 500 million organisms was given.

A useful variant of this routine was employed in a small number of cases of uveitis seen at the Crile General Hospital Eye Center, where it was suggested by Lt. Col. Mahlon H. Delp, MC, chief of the medical service. The vaccine was injected intravenously in the proper amount, and the temperature was taken every 30 minutes until a peak elevation was reached and it began to drop. At this time, a second injection of vaccine was given, in the same amount as the first dose. This method was used in four cases in which the response to other forms of therapy had been disappointing. The febrile reaction following the first dose was between 101° and 102° F. and was 104° F. following the second injection. The patients showed no ill effects.

In a fairly large number of cases, the response to injections of typhoid vaccine was disappointing. Even when large doses were used, there was no apparent effect in some cases; in one case, for instance, no febrile reaction followed the use of 800 million killed organisms in a single injection.

Ophthalmologists at Crile General Hospital were of the opinion that the erratic febrile response of many patients with uveitis to typhoid-fever therapy could be explained by the fact that Army personnel had been routinely immunized with typhoid vaccine. A study carried out by Maj. Harold G. Scheie, MC, in the China-Burma-India theater corroborated this impression. In comparative tests on Chinese troops who had not been immunized against typhoid fever and United States troops who had been thus immunized, much higher febrile reactions followed typhoid-vaccine injections in the Chinese troops than in the United States troops although the same doses of killed organisms were used for all patients.

Artificial fever therapy.—When it became clear that good results could not be anticipated with typhoid-vaccine therapy or when for any reason this form of therapy could not be used, hyperpyrexia was induced by means of the fever cabinet. The general practice was to induce a therapeutic elevation between 104° and 105° F. and maintain it for 6 hours. It was later found, however, that a temperature of 104° F. was adequate. At Crile General Hospital, less protracted therapy was used, since it had been found that a maximum elevation between 104° and 105° F., maintained for only 2 hours, gave excellent results. It required approximately 1½ hours to reach this elevation and about an hour to lower the temperature to normal, so that by this method the patient spent only 4½ to 5 hours in the fever cabinet.

In the opinion of many observers, the treatment of uveitis in the fever cabinet was preferable to the use of typhoid-vaccine therapy. The patient was spared the chills, headaches, and malaise associated with the latter, and the nursing problem was thus simplified. Artificial fever therapy could be

employed by means of the fever cabinet on successive days, while typhoid-vaccine therapy could not safely be used more often than once every 3 days because of the possibility of a secondary reaction on the day following its administration. These advantages were in addition to the fact that some patients, because of such contraindications as the presence of systemic diseases and for other reasons, could not safely be given typhoid organisms.

It is a matter of interest that, in two cases treated in the fever cabinet at Beaumont General Hospital, the patient presented the mutton-fat keratic precipitates and Koeppe nodules on the iris regarded as associated with tuberculous uveitis. Although neither of these patients received treatment for tuberculosis, they both improved promptly and strikingly after induced hyperpyrexia.

In a case at the Crile eye center, in which the patient was entirely unresponsive to typhoid-vaccine therapy, even after 800 million killed organisms had been injected at one time, artificial fever therapy was administered in a novel manner. The fever cabinet could not be used because of lack of personnel, but temperature elevations of 104° to 105° F. were achieved and maintained for 4 hours by the use of hot baths, as suggested by Capt. Lewis N. Rudin, MC, chief of the physical-therapy department.

Other measures.—Patients who showed sensitivity to tuberculin were treated in most installations as if the sensitivity did not exist. Desensitization with tuberculin has always had rather uncertain results, and it was particularly difficult to carry out in the Army because of the length of time required for the course, the frequent changes of station of the soldier, and the shortage of trained personnel to administer it. In most installations, if it was thought that tuberculin desensitization was indicated, the patient was separated from service on a Certificate of Disability and referred to a veterans' hospital for treatment.

On the assumption that some forms of chorioretinitis have a vasospastic basis, 64 patients at the O'Reilly General Hospital Eye Center were treated with histamine. The plan was to administer it intravenously, for 8 successive days, in the proportion of 1 mg. of histamine to 200 cc. of physiologic salt solution. The infusion was given very slowly. No beneficial results were observed in any of these patients, nor was any improvement observed in the few cases in which the method was used at other eye centers.

Local diathermy was not generally used in the treatment of uveitis in the eye centers of the Zone of Interior and gave poor results when it was employed.

Surgical measures.—Surgical measures in uveitis were limited to the attempted removal of intraocular foreign bodies and to enucleation of the eye if there was no response to treatment, if the inflammation continued active, and if sympathetic ophthalmia developed or was apparently developing.

SYMPATHETIC OPHTHALMIA

Among the 400 cases of uveitis treated at O'Reilly General Hospital during World War II, there were four instances of sympathetic ophthalmia, all confirmed by pathologic examination of the enucleated exciting globe. In 3 of the 4 cases, the sympathizing eye became involved within 6 months of the initial penetrating injury to the exciting eye. In each of these three cases, the exciting eye was enucleated early, and the inflammatory process in the sympathizing eye subsided so promptly that the final visual acuity in each instance was 20/20. In the fourth case, sympathetic ophthalmia developed more than 30 years after the original injury. The exciting eye was removed, and the inflammatory process in the sympathizing eye subsided, with a return of visual acuity to 20/20. Improvement was not permanent, however, and when the patient was last seen the details of the fundus were obscured by considerable exudate in the vitreous, and vision was not better than 20/40.

In a case observed at Dibble General Hospital, a foreign body which had been present for 7 months was removed from the vitreous through the anterior route. Enucleation of the eye later became necessary, and a few days later, sympathetic ophthalmia developed in the remaining eye. The process promptly became quiescent, and, when the patient was last seen, approximately 6 months afterward, visual acuity was 20/20.

Observation of the cases of sympathetic ophthalmia which developed in connection with uveitis in Army general-hospital eye centers in World War II revealed practically nothing that was not already known about this condition. Additional evidence was furnished, however, as in the case observed at O'Reilly General Hospital more than 30 years after the original injury, that sympathetic disease can develop after many years, even when the exciting eye has in the interim remained asymptomatic and apparently free of inflammation. When patients with eye injuries which might later cause sympathetic ophthalmia were discharged from the hospital or separated from service, it was therefore impressed upon them that they should submit to examination at regular intervals for the remainder of their lives.

DISPOSITION

The disposition of the soldier with uveitis, whether of traumatic or idiopathic origin, presented a problem. If the disease was of traumatic origin, sight was often seriously damaged by the time he was first seen. If the disease was of idiopathic origin, even if treatment produced good results and his general health was sound, recurrence was always a possibility.

The general principles of disposition were about as follows:

1. Patients who had had only a single attack and who had responded promptly to treatment were returned to full duty.

2. Patients who had responded to treatment but who still had visual damage were returned to limited duty in the Zone of Interior, if they could meet the minimum requirements for service.

3. Patients who had undergone recurrent attacks, who had frequently been hospitalized for long periods of time, and in whom further recurrences could be anticipated were treated in a hospital until maximum benefits had been attained. They were then discharged from service on a Certificate of Disability. Patients with bilateral disease were never retained in service.

4. Patients who showed limited benefits after an adequate period of hospitalization and appropriate therapy and who would apparently require treatment for months and even years were discharged direct to the care of the Veterans' Administration. For the most part, the patients in this group had uveitis of proved or suspected tuberculous etiology.

5. As a general rule, patients whose disease could not be placed on a definite etiologic basis, particularly if they had had recurrent episodes of uveitis, were separated from service even if they had responded well to treatment. Patients in whom a probable etiologic factor was identified and could be corrected frequently showed striking improvement after treatment, particularly after the eradication of foci of infection. Whether the improvement was the result of treatment or was the natural course of the disease cannot be said positively; many patients improved whether or not an etiologic basis was found and whether or not the supposedly responsible etiologic factor was corrected. It was believed, however, that recurrence was probably less likely if all possible causative factors had been eliminated, and patients who had responded well to treatment and who could meet the visual acuity standards of the Army were usually returned to duty of some kind.

6. Patients who had undergone an enucleation were retained in service or were discharged according to the regulations then current concerning one-eyed soldiers.

CHAPTER XIII

Retinal Detachments

Harold E. Wager, M. D.

Retinal detachment was a frequent clinical diagnosis, although not all the admission diagnoses were later confirmed.[1] During the earlier months of the war, traumatic chorioretinitis with associated retinitis proliferans was at times mistaken for detachment of the retina. The fact that the number of such errors was considerably less in the later months of the war supports the speculation that the lesions were mistaken for each other earlier in the war because medical examiners were not familiar with the appearance of these traumatic lesions. The error did the patient no harm and indeed was actually beneficial because some restriction of activity was imposed on him by orders of the medical officer.

On the other hand, many patients with retinal detachments were admitted to the hospital without diagnosis of the condition which was recognized only on the initial ophthalmologic examination. In other instances, the lesion apparently developed during hospitalization, particularly in patients who had suffered penetrating wounds of the eye. The diagnosis of retinal detachment was correct in the great majority of the patients who were admitted to eye centers from medical installations in the Zone of Interior. In these cases, the detachments were chiefly of the idiopathic type, associated with bullous detachment and with a hole or tear of the retina.

ETIOLOGIC FACTORS

Hospital admissions for retinal detachment changed in character as the war progressed. The first cases, from posts, camps, and stations in the Zone of Interior, represented, for the most part, traumatic and idiopathic types. In many cases finally diagnosed as idiopathic, a history of trauma was elicited, which in some instances was probably relevant and in others was merely accidental. Apart from any other consideration, numerous admissions for idiopathic retinal detachment could have been expected among the millions of men inducted into service, since this condition is by no means unusual in civilian practice. Numerous cases were the direct result of blows to the eye incurred during the rigors of training. A blow from a rifle stock was typical of this type of injury. Many other cases were the result of accidents during

[1] A statistical presentation of diseases of the eye in the United States Army during World War II is contained in appendix A, pp. 549–555.

authorized athletics, such as occurred when a man was struck in the eye by a baseball.

Unilateral lesions were the rule in this group of cases. The patients, who practically always reported for medical attention immediately after the injury, were at once hospitalized, and their activity was restricted. They were usually transferred to the eye centers as litter patients.

Another type of accidental injury encountered early in the war was caused by explosions during training in the Zone of Interior. Retinal detachments in these cases were usually not diagnosed before admission to the eye centers because the damage, which was most often bilateral, was so severe that detailed examination was not possible for some time. These head injuries were usually associated with injuries to the trunk and limbs, and the patients were therefore necessarily transported by litter.

Retinal detachments were not observed in appreciable numbers in casualties from overseas until activities in the overseas theaters were conducted on a large scale. Frequently, several months might elapse between the injury or the appearance of symptoms and evacuation of the patient from overseas to specialized hospitals in the Zone of Interior. As the tempo of war increased, the number of detachments resulting from penetrating wounds of the eye materially increased. The histories given by these casualties indicated that they were originally classified as litter patients but that the classification often had to be changed because of lack of personnel and other exigencies of warfare. Most eye casualties, in the absence of other injuries, were apparently hospitalized as ambulatory patients.

NATURE OF THE LESION

Penetrating wounds.—The majority of battle-incurred retinal detachments were directly related to penetrating wounds of the globe or were the result of direct trauma in the region of the globe. Detachments associated with penetrating wounds more often than not developed some months after the initial injury, though in many instances they had probably existed for some time before they were recognized. It is easy to understand why the diagnosis was overlooked in cases in which phthisis bulbi followed the penetrating injury or in cases in which the detachment was obscured by cataracts.

Detachment of the retina apparently occurred much more readily in eyes in which the ciliary body had been penetrated than in those in which penetration was through the lens, the ciliary body escaping, or through the sclera posterior to the ora serrata. In most cases, the detachment was apparently initiated by proliferation of the ciliary epithelium, with extension into the vitreous and the retina. The contraction of the mass of proliferated tissue, which often could be seen by direct visualization, was later responsible for the detachment.

In cases in which cataract formation followed injury, the detachment was often not discovered until the cataract was removed or had become absorbed. Whether the detachment existed before removal of the lens and had not been

discovered or whether it was the result of vitreous degeneration which had been compensated for by the swollen lens while it remained *in situ*, it is not possible to say. In cases such as these, retinal holes were seldom observed.

Direct trauma. In the cases, which were not numerous, in which direct trauma to the globe resulted in detachment of the retina, a hole or tear was usually present. These cases, therefore, properly belonged in the same category as serous spontaneous detachments. As a rule, an associated area of chorioretinitis, cystic degeneration, or active inflammation had previously been present, though it was often quite difficult to identify it. Cases in which vitreous hemorrhage followed trauma in the region of the eye probably also belonged in this category. In a small number of instances, organization occurred and traction was responsible for the detachment.

Foreign bodies. Cases were observed in which a foreign body located in the vitreous had become attached to the retina by bands of fibrous tissue which later had contracted and caused retinal detachment. Fibrous strands produced along the path of a foreign body which had passed through the globe were also noted in some cases. Due consideration was given to the presence of these strands before attempts were made at magnetic removal of the foreign body. The opinion was that there was less danger of separation of the retina when the foreign body was removed by the transscleral route, over the site of attached fibers, than through the pars plana, since traction is unavoidable by the latter route and separation of the retina is thus facilitated. In one such case, in which the foreign body was located behind the equator, the pars plana route was used, and it was thought that, when the magnet was applied, the foreign body had been dragged across the retina and had produced a tear, which explained the later detachment. The possibility, of course, could not be excluded that strands might have extended from the foreign body to the retina and that traction was responsible for the detachment. In an occasional case, complete retinal detachment followed the use of the Thorpe endoscope. The usual protective measure of employing surface diathermy around the site of the scleral wound was taken in all operative removals of foreign bodies.

Idiopathic retinal detachment. Idiopathic retinal detachments were seen throughout the war but were proportionately more numerous in the early months, as has already been noted. They were either unilateral or bilateral. The infrequency of associated myopia was surprising, though, when it was present, the usual degenerative changes were noted. In most cases, there were extensive areas of cystic degeneration, together with retinal holes, and, in some instances, areas of healed chorioretinal lesions were observed. Retinal detachments of idiopathic origin were usually of relatively short duration and offered the best prognosis.

Detachment of other origins. A diagnosis of Eales's disease was made in a number of cases of retinal detachment observed at the Valley Forge General Hospital Eye Center. In one of these cases, though the picture was atypical, massive subretinal hemorrhage was associated with the detachment. In

several cases, it was difficult to visualize the fundus because of vitreous opacities. No case of exudative retinitis externa was definitely identified, though in at least one instance it is believed that such a diagnosis would have been justified. Retinal detachment associated with intraocular tumors presented the findings usually observed under such circumstances in civilian practice.

The observations at the Valley Forge General Hospital Eye Center may be assumed to be typical of those made at other specialized centers, in which the material was much the same.

DIAGNOSTIC ROUTINE AND PREOPERATIVE MANAGEMENT

Diagnosis of idiopathic retinal detachments was seldom difficult. It was usually possible to obtain a typical history of early muscae volitantes and photopsia, and, somewhat later, of loss of a portion of the visual field. Diagnosis in some traumatic cases was quite difficult, the fundus being obscured by the presence of a cataract. In such cases, diagnosis was usually made by the demonstration of loss of light projection in various fields. The presence or absence of a foreign body was always given due consideration.

The diagnostic routine began with a complete examination of the eyes as soon as possible after the patient's admission, both before and after mydriasis. Visual acuity and fields were determined. Repeated examinations were made before operation to identify holes or tears in the retina. It was routine for the surgeon to make a final examination immediately before the patient was taken to the operating room, so that he might be thoroughly familiar with the findings and, if holes or tears existed, might know their location as well as the extent of the separation. At some centers, it was the custom to make a sketch or diagram of each separation prior to operation.

If the cause of the retinal separation was not clear, a routine search was made for possible focal causes. Examinations under these circumstances, in addition to the usual studies, included dental, otolaryngologic, and urologic consultations; serologic studies; and agglutination tests for brucellosis. If a focus was found, definitive treatment was instituted before operation.

If a diagnosis of retinal detachment was confirmed, the patient was immediately put on bed rest, with atropinization, and was given pinhole spectacles. As a rule, preoperative bed rest lasted for at least 7 days, though in occasional special cases the period was shortened. In cases in which the detachment was due to the presence of a tumor, operation, after proper consultations, was proceeded with promptly, since enucleation was necessary.

TECHNICAL CONSIDERATIONS

At the Valley Forge General Hospital Eye Center, operations for retinal detachment were usually carried out under thiopental sodium anesthesia.

After induction of anesthesia and the usual preparation and draping, the conjunctiva and Tenon's capsule were incised, and the underlying sclera was exposed over the desired area. As a rule, one or more rectus muscles were then identified, sutured, and resected, traction sutures being inserted in the insertional stump of the resected muscle. The pars plana was measured, and identification sutures of black silk were inserted. Surface diathermy was carried out over the desired area, which always included a wide margin of healthy tissue around the localized tear or hole. The Weve monopolar electrode with needlepoint or ball electrode was used for this portion of the procedure and was connected with the Walker diathermy set, at 45 to 50 milliamperes. When diathermy was applied, extreme care was taken not to injure the vortex veins or to approach too closely to the region of the macula and the ciliary body. Through-and-through punctures were made in the region of tears by means of the Weve instrument or Walker pins. If fluid could not be obtained readily, a punctum dilator was inserted into one or more of the points of puncture, to secure adequate drainage. Insertion of the Walker pins was frequently done under direct visualization, so that the tear could be localized accurately. If the detachment was extensive, and usually in instances of disinsertion, numerous through-and-through punctures were made.

In the majority of cases, the remainder of the operation consisted only of reattachment of the severed rectus muscle or muscles to their insertion, with closure of the conjunctiva. Black silk sutures were used for closure of the conjunctiva and chromic catgut sutures (#0000) for reattachment of the muscles. In a small number of cases, a 1.5-mm. trephine opening was made in the most dependent portion of the detached area. In all cases, atropine was instilled, and a binocular dressing was applied with a shield.

Scleral shortening operations were not attempted in any case treated at the Valley Forge General Hospital Eye Center. There was also no attempt to immobilize the eye following surgery by fixation sutures or to tenotomize the four rectus muscles.

The procedures described were followed, with individual modifications, at all of the eye centers. At the Crile General Hospital Eye Center, for instance, operations for retinal detachment were carried out with the Liebel-Flarsheim unit and the retinal-detachment-kit attachments. At this center, it was customary to use the single insulated tip almost exclusively to perform an extensive barrage of the involved area. In certain cases, surface coagulation with the ball-tip electrode was also carried out in the area of the tear. In this center, however, contrary to the practice at the Valley Forge center, scleral resection was performed at the time of the original operation whenever large disinsertions of the retina were present. It was believed by the ophthalmologists at this center that, whenever this procedure was indicated, the eye was in better condition to withstand it at the time of the first opera-

tion, when it could be done as an original procedure, than later, after other procedures had been carried out.

POSTOPERATIVE CARE

Postoperation care in retinal detachments always followed the same general plan. The patient was kept strictly confined to bed for periods varying from 15 to 30 days, depending upon the indications in the individual case and the practice of the individual surgeon. Not a great deal of attention was paid to the effects of gravity in choosing the position of the headrest, but most patients were kept in the dorsal recumbent position, with the head at first kept immobilized by sandbags. Binocular dressings were maintained for at least a week and in many centers for longer periods. Later, Lindner goggles or other types of pinhole spectacles were worn, in some centers for 2 months or more. Some ophthalmologists, however, found little difference in results whether or not pinhole glasses were used.

In some centers, the first dressing was done on the fourth day and in others a little later. As a rule, dressings were changed every other day until they were permanently discarded, usually about 21 days after operation, though sometimes not until 30 days afterward. This policy was followed, not because the dressings were regarded as of particular value but because the patients were active young men, often with nothing the matter with them except the eye injuries, and activities beyond those desirable were likely to be taken once the eyes were uncovered. The crucial postoperative period was, as usual, between the 2d and 10th days, but harm could be done by unwise activity and exertion at a later period. The ambulatory status was preferably resumed gradually.

Atropine was instilled at each dressing unless a sensitivity to it developed. If that occurred, other cycloplegics were used. The eyes of ambulatory patients were usually kept atropinized, sometimes for as long as 60 days.

Other postoperative measures were routine. The influence of diet on water metabolism was, for the most part, ignored. For the first 24 hours after operation, the intake was confined to fluids, and for the next several days it consisted of soft foods, according to the usual civilian routine. Thereafter, the patient was given the regular hospital diet.

REOPERATION

At the Valley Forge General Hospital Eye Center, in cases in which the first operation was not successful the procedure was repeated after 14 to 21 days and, if necessary, one or more times thereafter. If several efforts resulted in failure, the Guist operation was resorted to. After the affected area had been exposed by the method described, trephine openings (1.5 mm.) were made at selected points, and crystalline potassium hydroxide, immediately neutral-

ized with 5 percent glacial acetic acid, was applied to the exposed choroid. Punctures were then made through the choroid by way of several of the trephine openings, in order to liberate the subretinal fluid. Closure was by the usual technique. The Guist procedure was generally regarded as the final effort to secure reattachment of the retina.

At the Northington General Hospital Eye Center, before secondary operations were performed a trephine was sometimes first made, in an attempt to improve drainage of the subretinal fluid. The attempt was sometimes successful.

In some cases, as many as five operations were performed before the attempt at improvement was abandoned. Repeated surgery introduced postoperative difficulties in patients with one normal eye. These patients, after several operations, were found to be far less cooperative about postoperative inactivity than they had been after the first operation and were also far less cooperative than patients on the blind program.

PROGNOSIS AND RESULTS

The results of operations for retinal detachment depended in a large measure upon the degree of pathologic change present. A cure was considered to have been achieved if, on examination after operation, the detached portion of the retina had been reattached and the visual field correspondingly enlarged. If the macula had been primarily involved, improvement in central vision was not taken into account in determining whether or not a cure had been effected.

The most favorable results were observed in idiopathic retinal detachments, in which success was accomplished in 70 to 80 percent of all cases. These results correspond with results to be expected in this type of case in civilian practice. In the idiopathic group, conditions for operation were usually favorable. In most instances, the detachment had been of relatively short duration, usually less than two-thirds of the retina was affected, and holes or tears were single.

The percentage of successful results was considerably smaller in cases of traumatic origin, especially if several months had elapsed between the injury and the reparative operation. The prognosis was poor in cases in which traction bands were present, including cyclitic membranes as a result of intraocular disease and contracting vitreous bands as a result of penetrating wounds. Attempts to sever vitreous bands were not regarded as practical. The prognosis was also regarded as hopeless in retinal detachments associated with Coats's or Eales's disease, and operation was not attempted, even though it was the practice in all eye centers to operate in any case in which there was even a minimal chance of reattachment. Finally, cases were also considered hopeless in which the detachments were of the complete funnel-shaped type, the retina was folded on itself, or there were multiple large holes. The great majority of such cases, as a matter of fact, were observed in blinded patients, and in most

instances there were other ocular injuries or diseases in addition to the retinal detachment.

The disease or injury was, in itself, the chief factor which influenced prognosis. Age played no part in the results of retinal detachment in military practice, since practically all the patients were in the second or third decade of life. It was the impression, though statistical proof is lacking and no explanation can be advanced, that results of operation to correct retinal detachments were somewhat better in Negro than in white soldiers. Intraocular tension, except in the occasional case in which it was initially quite low, seemed to play no part in the outcome.

DISPOSITION

Final disposition of patients with retinal detachment depended upon the original cause of the condition as well as upon the end results. Patients with idiopathic detachment, who presented cystic degeneration with or without myopia, were recommended for Certificate of Disability discharges, regardless of the success of operation on the affected eye or the vision in the remaining eye. The reason was the well-known possibility of retinal detachment in the sound eye.

Patients with bilateral detachment, regardless of the cause, seldom showed sufficient vision to meet the Mobilization Regulations 1–9 standards.[2] Even when the standards were met, separation from service was still recommended because of the possibility of secondary detachment.

Patients with uniocular detachment due to trauma were returned to limited duty after operation if the results were good. If surgery had been unsuccessful, separation was recommended because of the possibility of later secondary complications. Patients who required enucleation because of degeneration of the eye were fitted with a prosthesis and were returned to limited duty or separated from service, according to the exigencies of the individual case. No patient with retinal detachment admitted to the blind program had vision restored to such an extent that a return to duty seemed practical.

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[2] Mobilization Regulations 1-9, 15 March 1942.

CHAPTER XIV

Management of Cataracts in Military Personnel

John S. McGavic, M. D.

The management of cataracts at the Valley Forge General Hospital Eye Center may be taken as typical of the management of cataracts in military personnel at other eye centers in the Zone of Interior. The general principles of management were essentially the same everywhere, but, since military ophthalmologists had been trained in many different civilian institutions, their opinions and practices reflected the variations which exist in civilian practice.

TRAUMATIC CATARACTS

By far the largest number of cataracts observed in military practice were traumatic in origin. They followed direct or indirect contusion, penetrating and perforating wounds in which no foreign body was present, entrance of foreign bodies into the lens, and siderosis or chalcosis secondary to foreign bodies which might or might not have entered the lens. Except for the presence of foreign bodies, the type of wound which had preceded the cataract was not as important as the complicating factors, which included luxation or subluxation, secondary glaucoma, traumatic uveitis, and detachment of the retina.

Antecedent contused wounds.—Cataracts caused by contusion were usually monocular. It was customary to let them alone unless they were complicated by luxation or by glaucoma secondary to swelling of the lens. Luxation, with or without glaucoma, was relatively frequent in contused wounds.

Antecedent penetrating and perforating wounds.—Penetrating and perforating wounds were the most frequent cause of the cataracts encountered in military practice. If absorption seemed to be occurring, and if secondary glaucoma or excessive uveal irritation was not a complicating factor, absorption was allowed to proceed without operative interference. Foreign protein therapy for quieting uveitis and hastening absorption was preferred over routine lavage of the anterior chamber. Patients with monocular cataract who became slowly aphakic, or practically aphakic, as a result of absorption of the lens, were almost always happier than those whose aphakia was produced by operation, for the reason that they became accustomed to their new visual limitations gradually rather than abruptly. A psychologic factor was also important; since patients expect a better result from operation than from

natural processes, they are likely to be better content with a final result which comes about spontaneously.

Antecedent injury of the lens by foreign bodies.—Cataracts following injury of the lens by foreign bodies were also frequent. Whenever it was feasible, removal of the foreign body was the first step and correction of the cataract the second, though in some instances, removal of the cataract was a more practical first step because it was then possible to visualize the foreign body for removal with a magnet or forceps. If the foreign body lay in the anterior chamber, preservation of the iris-lens diaphragm was important. If it lay in the lens, removal was accomplished with forceps, sometimes aided by the magnet. Absorption of the remaining cortex usually proceeded smoothly. If the foreign body lay behind the cataractous lens and was known to be magnetic, it was usually possible to remove it without direct visualization. The Berman locator was a valuable adjunct to roentgenologic localization in such cases.

Associated siderosis and chalcosis.—Cataracts associated with siderosis were managed by the same plan as those caused by foreign bodies in the lens. In numerous instances, the foreign body had already been removed when the patient was first seen. When complications such as vitreous hemorrhage, detachment of the retina, and iridocyclitis were present, cataract removal was less frequent than enucleation. If the cataract was unilateral, surgery was not advised for the reasons already mentioned. As a result of these various considerations, operation was not carried out in many cases of cataract associated with siderosis unless there had been a direct injury to the lens.

Cataracts associated with chalcosis presented a somewhat different problem. The copper foreign body, being nonmagnetic, usually had not been removed and whether or not it could be depended upon its location. Foreign bodies lying in the anterior chamber or in the lens could be extracted with relative ease. When a copper particle in the vitreous could not be removed, about all that the ophthalmologist could do was to watch the lens become increasingly opaque as chalcosis developed. Since vision usually remained good for long periods of time, not many cataracts caused by chalcosis alone, without direct injury to the lens, came to operation in Army hosiptals. Veterans' hospitals will undoubtedly be called upon, however, to deal with many such cases in the future. Patients discharged with cataracts associated with chalcosis caused by retained foreign bodies were always instructed to report at once to the Veterans' Administration to arrange for observation at regular intervals.

Dislocated lenses.—In cases in which secondary glaucoma had developed, the luxated or subluxated lens was extracted, usually with a loop but sometimes with capsule forceps. Some lenses were removed in anticipation that glaucoma might develop later, without the patient's being aware of the condition.

Blind eyes.—Blind eyes which were asymptomatic and not inflamed were usually left undisturbed, whether or not glaucoma had occurred.

Surgical Measures

In the early months of the war, traumatic cataracts, especially if partially absorbed, were often treated by repeated needling operations. Repeated discission, although an acceptable method of treatment, has certain dangers and disadvantages. Infection is always a possibility. Iridocyclitis may result from manipulation. Mixing the vitreous with lens material is a possibility. Retinal detachment may follow operation. Temporary secondary glaucoma sometimes develops and requires irrigation of the anterior chamber. Absorption of the lens material is delayed in patients with unusually large nuclei. Hospitalization is required for much longer periods than when linear extraction is done.

For these various reasons, repeated discission was gradually discontinued, and cataracts were treated by linear extraction, either in a single-stage operation or by opening the capsule in the first stage and irrigating lens material from the anterior chamber in the second stage.

OTHER TYPES OF CATARACTS

Congenital cataracts.—Not many congenital cataracts were observed in the Army, though some cases in which the cause was not determined probably belonged in this category.

Only a few patients were treated surgically. Those with adequate visual acuity for limited duty were retained in the service, to be rechecked at regular intervals. Those whose vision fell below the minimum standards for limited duty but was not so poor that surgery was advisable were returned to civilian life without operation.

It was frequently difficult to persuade patients who had observed no symptoms until they were on active service that their cataracts had not been incurred in line of duty. Almost without exception, they thought that if the lesions had existed previously, they would have been recognized at the time of induction.

Senile cataracts.—Few purely senile cataracts were encountered in Army personnel because of the youth of most of the group and the high physical standards required for induction. The usual criteria for operation were observed in these cases. Intracapsular extraction through a round pupil with peripheral iridotomy or iridectomy was the surgical procedure of choice.

Cataracts complicating uveitis.—Although a moderate number of cataracts were observed in association with uveitis, most of them were monocular and did not require surgery. In the few cases of bilateral cataract, all possible foci of infection were eradicated, and general and local measures were employed until the uveitis had been inactive for a considerable period. Then combined extracapsular extraction with complete iridectomy was the procedure of choice.

Posterior lenticonus.—Only a single instance of bilateral lenticonus was

observed at the Valley Forge General Hospital Eye Center. In that instance, one eye was successfully treated by discission followed by irrigation of the anterior chamber.

Diabetic cataract.—Since diabetes was a reason for rejection for service, or for return to civilian life, it played no role in the cataracts observed in military ophthalmology.

MONOCULAR CATARACT

Patients with cataract in one eye and with a clear lens in the opposite eye presented something of a problem. Such individuals were considered fit for limited duty, just as one-eyed persons were considered fit for this type of duty. Both groups were equally unhappy in service.

Many patients with monocular cataract requested its removal, whether it had existed previously or had developed since induction. Cataracts which had existed before military duty were not removed unless they were producing secondary glaucoma, and the majority of military ophthalmologists did not favor operation for monocular cataract even when it had developed during service.

The happiest soldier with monocular cataract was the man with a secondary membrane, whether it followed absorption of the cataract or removal of the lens. These patients, as their acuity was low, had little confusion or diplopia. Since the membrane acted as a fairly good filter, they also had a little light sensitivity. On the other hand, the cosmetic appearance was fairly satisfactory, and it seemed psychologically important to the soldier to know that he "no longer had a cataract." Moreover, he had a fair field of vision for large objects and light. Most of the men in these circumstances were satisfied when told that, if discission proved necessary, it could be done at any time, and they waited for this procedure more readily than for removal of the cataract.

GLASSES FOR APHAKIC PATIENTS

The difficulties encountered in fitting glasses on aphakic patients at Valley Forge General Hospital were not easy to understand. Although the hospital was less than a hundred miles from the optical house which furnished the lenses, it took from 3 to 6 weeks to secure glasses. The quality of the lenses was poor, and the frames were equally unsatisfactory. Many aphakic patients purchased their own frames and lenses in order to obtain comfortable, well-fitted spectacles within a reasonable length of time. Since at all times from 400 to 850 patients with various ocular conditions were hospitalized at the Valley Forge General Hospital, it would have seemed wise to set up an optical dispensary unit to supply spectacles rather than to rely on a commercial house which did not provide good service.

CHAPTER XV

Nutritional Amblyopia in American Prisoners of War Held by the Japanese

Samuel M. Bloom, M. D., Earl H. Merz, M. D., and William Wickham Taylor, M. D.

The 33 soldiers who form the basis of this chapter were captured on Bataan and Corregidor in April and May 1942 and remained prisoners in various Japanese prison camps, under conditions of severe malnutrition, until they were liberated early in 1945. The development of the nutritional amblyopia which they presented was observed in its early stages by one of the writers (S. M. B.) while he was himself a prisoner in Cabanatuan. The residual findings were observed by the other writers while the patients were hospitalized in the Valley Forge General Hospital Eye Center in the Zone of Interior. In the interval between their liberation and their arrival at this eye center, the patients had received adequate diets, supplemented by vitamin therapy, and had returned to approximately their normal weight.

INITIAL OBSERVATIONS IN PRISONER-OF-WAR CAMPS

From the time of their captivity, the survivors of the American forces on Bataan and Corregidor were subjected to living conditions which led to malnutrition, various vitamin deficiencies, and, in some instances, to death from starvation in Japanese prison camps in the Philippines. In the main, the daily diet consisted of about 300 gm. of polished rice, together with a thin soup made of weeds and of vegetables of poor quality. Fruit was occasionally furnished but in quantities so small as to be negligible. Meat was almost completely lacking. Occasionally, one pig would be furnished for a group of 2,500 men. After it was dressed and cooked, about all that appeared in a serving of soup would be a bit of hide and a few shreds of meat.

As a result of this diet, both the wet and dry types of beriberi, scurvy, pellagra, ariboflavinosis, and xerophthalmia, to mention only a few of the clinical syndromes which became apparent, developed in the prisoners during the first 4 months of imprisonment. In most cases, the picture was naturally that of a mixed avitaminosis, with one manifestation or another predominating. In addition, malaria, amebic and bacillary dysentery, and diphtheria affected

many of the prisoners. Of about 6,500 men held at Cabanatuan, about 2,700 died during the first year of imprisonment.

The onset of amblyopia was insidious. Impairment of vision was first reported in September 1942; that is, after about 4 months of starvation diet. Most of the patients described the impairment of vision as an intermittent fading, more marked in bright sunlight, which gradually became more pronounced. Some patients did not notice it at all. Two to four weeks later, burning sensations and retrobulbar pain began to appear in the late afternoon of bright, sunny days, or during the early evening. The attacks were accompanied by photophobia and lacrimation. Mild injection of the conjunctiva was present in a few cases, but as a rule examination at that stage revealed no gross external alterations of the eyes. It should be emphasized that examination, like treatment, was necessarily limited. No visual test charts were available, and there were no materials with which to improvise them. Ophthalmoscopes, lenses, and other types of equipment were lacking, and there were almost no medicines.

By October 1942, attacks of burning of the eyes and of retrobulbar pain had become pronounced, and the cornea appeared dry and roughened. A day or two after this condition was observed, superficial ulcers would appear. These ulcers were present over the pupil or the lower half of the cornea and usually appeared singly. The shape was, for the most part, round or oval. Circumcorneal injection became evident, but in most cases there was little infiltration of the cornea. No fluorescein or other staining agent was available, and observations were necessarily incomplete. When the small amounts of cod liver oil available were administered, most of the ulcers healed within 4 to 10 days, though a few went on to perforation or were complicated by hypopyon or iritis. Impairment of vision persisted in all cases and usually progressed.

In November 1942, as the result of a change in administration of the prison camp, the daily ration was improved. Rice was increased to 400 gm., meat to 50 gm., and squash and comotes (a variety of sweetpotato), were added to the diet. The ophthalmologic patients also received 4 ounces of evaporated milk daily and, when it was available, 4 ounces of carabao liver. The milk and carabao liver seemed to be most effective in arresting the development of corneal ulcers and in healing the manifestations of ariboflavinosis.

At this time, a visual test chart was constructed, and batteries were obtained for an ophthalmoscope, so that more detailed examinations became possible. Ophthalmoscopic examination showed pallor of the disk in the region of the papillomacular bundle. By December 1942, vision was reduced, on the average, to 10/200. It remained stationary thereafter in most cases, though in a few a slow decline continued. Central vision was chiefly affected. Central and cecocentral scotomas were observed, with moderate constriction of the peripheral fields.

At Santo Tomás, a camp for the internment of Allied civilians to which one of the writers (S. M. B.) was transferred at this time, the Japanese ration

was as inadequate as it had been at Cabanatuan, but it was permissible to receive or to purchase food from neutrals and from Filipinos outside the camp. Malnutrition and amblyopia were therefore not prominent. On 1 February 1944, traffic with outside sources was stopped, and by May inmates were beginning to complain of photophobia, retrobulbar pain, and diminution of vision, especially in bright light, just as at Cabanatuan. There were facilities for charting visual color fields at Santo Tomás. The earliest changes were observed in the blue field. The next changes were in the red and green fields and were accompanied by enlargement of the blind spot and constriction of peripheral fields. Still later, central or cecocentral scotomas became evident.

In January 1944, small supplies of thiamine chloride became available at Santo Tomás, from a shipment sent by the American Red Cross in August 1943, and it was possible to administer 25 mg. daily for 2 to 3 weeks to affected individuals. Multiple vitamins were given with the injections of thiamine chloride. This regimen served to check the progress of the disease. One fairly typical patient had lost 80 pounds over a 12-month period at Fort Santiago (a political military prison) and had developed beriberi, as well as central scotomas with diminution of vision to 10/200. By November 1944, after 8 months of the treatment outlined, he could read large print and his own handwriting, and his vision was 20/70. It began to deteriorate again the following month because of starvation, the diet having been reduced to 200 mg. of polished rice daily.

OBSERVATIONS ON LIBERATED PRISONERS IN ZONE OF INTERIOR

Typical Observations

All the liberated American soldiers studied at the Valley Forge General Hospital Eye Center in the Zone of Interior presented much the same clinical picture (table 6). The following case may therefore be accepted as typical.

The patient entered the eye center complaining of decreased vision in both eyes, inability to see objects when using central vision, and burning and pain in the extremities. He was a well-developed and well-nourished man, and physical examination on the medical service revealed no variations from the normal. Neurologic examination revealed peripheral neuritis and bilateral optic atrophy. Except for stool examination, which revealed intestinal parasites, all laboratory procedures (urinalysis, blood count, blood serology, blood chemistry, basal metabolic rate, electrocardiography, electroencephalography, cephalin flocculation test, and roentgenography of the lungs and heart) gave findings within the normal range.

External examination of the eye revealed no abnormalities of the lids, conjunctiva, sclera, or cornea. The lacrimal apparatus was patent, and the tactile tension was normal. Extraocular movements were within normal

TABLE 6.—*Ophthalmologic findings in 33 liberated American prisoners of war with nutritional amblyopia contracte in Japanese prison camps*

Cornea	Nerve head	Fundus	Peripheral fields	Central fields	Vision	Diet supplement	Camps	Onset of visual symptoms
Normal	Mild temporal pallor.	Macular mottling.	Normal	Central scotoma	20/200 20/50	No vitamins	Cabanatuan; Mukden.	November 1942.
Do	Temporal pallor	Normal	Mild constriction.	Centrocecal scotoma.	20/70 20/70	Few vitamins.	Wawa	July 1942.
Macula OD; normal OS.	Mild temporal pallor.	do	do	Central scotoma	20/200 8/200	do	Death March; Cabanatuan; Japan.	October 1942.
Normal	do	No foveal reflex	Normal	do	20/100 20/100	do	Cabanatuan	October 1942.
Do	do	do	do	Centrocecal scotoma.	20/50 20/200	Few vitamins	Death March; Davao; Korea.	July 1942.
Do	do	do	do	do	20/100 20/100	Few vitamins	Cabanatuan	January 1942.
Nebula OD; leukoma OS.	*Temporal pallor* OD; fundus not seen.	Normal OD	do	do	20/100 Hand movement.	Thiamine November 1942	Death March; *Cabanatuan;* Mukden.	July 1942.
Normal	Temporal pallor	No foveal reflex	Mild constriction.	Central scotoma	20/200 20/200	Few vitamins	Cabanatuan; Bilibid; Fort McKinley.	September 1942.
Do	do	do	Normal	do	20/100 20/200	Thiamine 1942	Cabanatuan; Korea; Japan.	September 1942.
Do	Mild temporal pallor.	Normal	do	Centrocecal scotoma.	20/70 20/100	Few vitamins	Cabanatuan	November 1942.
Do	do	do	Mild constriction.	do	20/70 20/200	Vitamins in hospital.	Cabanatuan; Bilibid hospital; July 1944 Japan.	November 1942.
Nebula OD; normal OS.	Marked temporal pallor.	do	Normal	Central scotoma	20/100 20/200	No vitamins	Cabanatuan; Japan November 1942.	November 1942.
Do	Temporal pallor	do	do	Small central scotoma.	20/200 20/100	None	Cabanatuan; Japan May 1943.	January 1943.
Normal	Mild temporal pallor.	do	Mild constriction.	Central scotoma for color.	20/40 20/40	5 months of vitamins.	Bilibid; Cabanatuan; Japan 1944.	March 1943.
Nebula OD; normal OS.	Moderate temporal pallor.	do	Normal	Central scotoma	20/100 20/100	Thiamine in hospital in Bilibid.	Cabanatuan; Bilibid hospital, Japan 1943.	October 1942.

Normal	Temporal pallor	do	Mild constriction.	do	20/200 20/200	None	Cabanatuan	October 1942.
Do	do	Macular mottling.	Normal	do	6/200 4/200	do	do	October 1942.
Do	Complete pallor	do	Mild constriction.	do	5/200 10/200	do	Bilibid	January 1942.
Do	Temporal pallor	Normal	Normal	do	20/200 20/200	do	Cabanatuan	August 1942.
Do	Complete pallor	do	do	do	1/200 1/200	6 months of thiamine.	Cabanatuan; Bilibid.	October 1942.
Do	Mild temporal pallor.	do	do	do	Light perception. do	None	do	September 1942.
Do	Temporal pallor	Macular mottling.	Mild constriction.	do	3/200 3/200	do	do	July 1942.
Nebula OD; normal OS.	do	Normal	do	Centrocecal scotoma.	20/100 10/200	Few vitamins	do	September 1942.
Normal	do	do	Normal	Central scotoma	20/200 10/200	None	Cabanatuan	December 1942.
Do	do	do	Mild constriction.	Centrocecal scotoma.	20/200 10/200	do	O'Donnell; Cabanatuan.	November 1942.
Do	do	Macular mottling OD; normal OS.	Normal	do	20/200 10/200	do	Cabanatuan; Bilibid.	October 1942.
Do	do	Normal	do	Central scotoma	10/200 10/200	Few vitamins	Cabanatuan	October 1942.
Do	do	do	do	do	5/200 10/200	None	do	October 1942.
Do	do	Macular mottling.	Mild constriction.	Centrocecal scotoma	1/200 2/200	do	Cabanatuan; Davao.	October 1942.
Do	do	Normal	Normal	Central scotoma	20/200 8/200	do	Cabanatuan	October 1942.
Do	Moderate temporal pallor.	do	do	Centrocecal scotoma.	5/200 5/200	do	Cabanatuan; Bilibid.	October 1942.
Do	Temporal pallor	Macular mottling.	Mild constriction.	Relative central scotoma.	20/100 20/70	Few vitamins	O'Donnell, Cabanatuan; Japan.	October 1942.
Do	do	Normal	do	Central scotoma	20/200 20/100	do	Cabanatuan	October 1942.

[1] Mukden diet good. [2] Davao diet good.

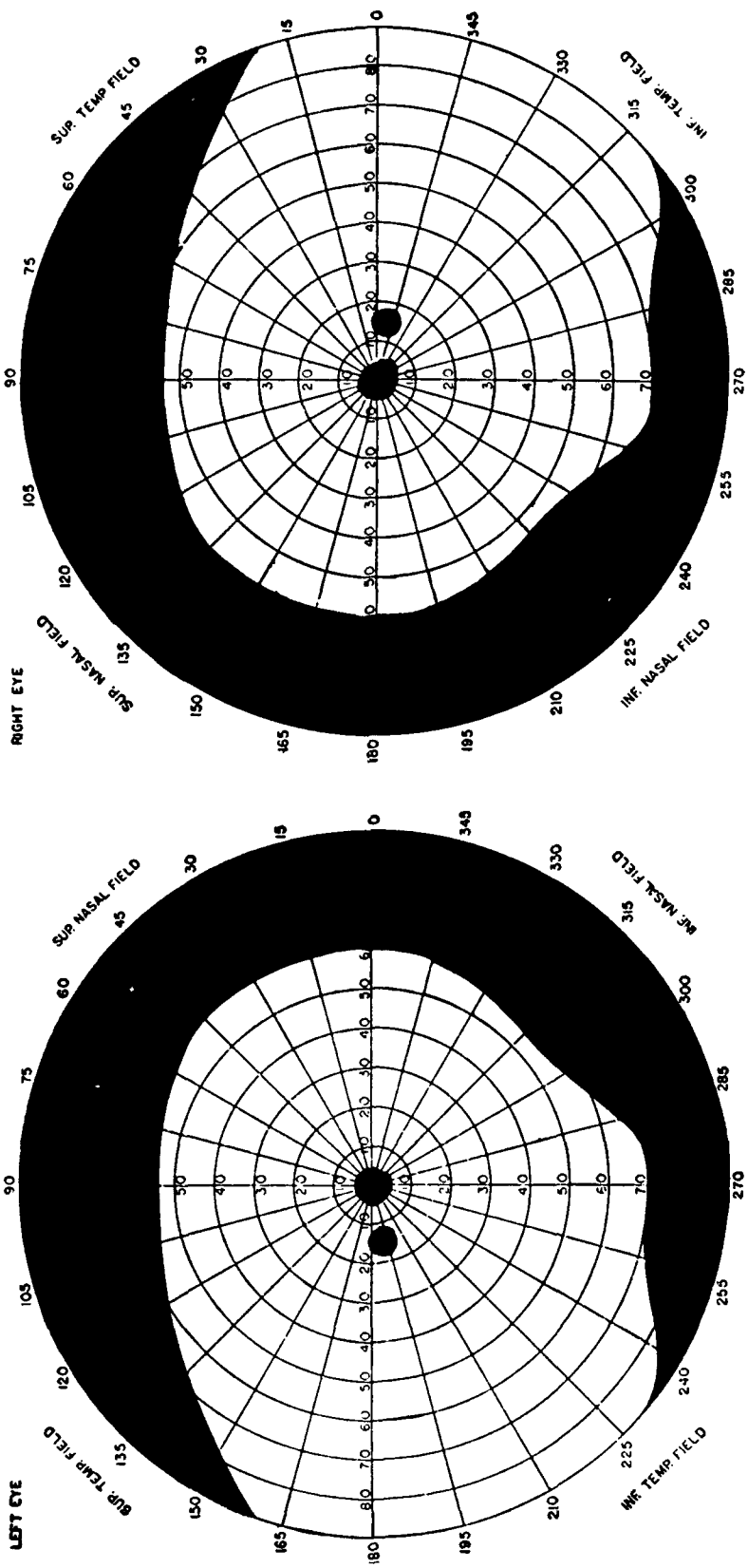


FIGURE 36. Central fields showing central scotoma of 5° to 8° with 1° target.

range, and the pupils reacted normally to light and accommodation. No lacrimation or photophobia was present. On slit-lamp examination, the cornea appeared normal, with no increase in limbal vascularization, no degeneration, no thinning, and no xerosis. The anterior chamber was of normal depth, and the aqueous ray was absent. No cells were seen. Ophthalmoscopic examination with the pupils well dilated showed clear media. The edges of the optic-nerve head were clearly defined and distinct, and no elevation or abnormal excavation could be observed. The temporal portion of the disk showed definite pallor; the nasal portion was relatively normal. The vascular tree was normal, and the periphery of the fundus revealed no pathologic changes. The macular area was normal. Vision in each eye was 20/200 and could not be corrected. The peripheral fields showed mild but not remarkable generalized constriction. The central fields showed two scotomas. One was a central scotoma of 5° to 8° with a 1° target under good illumination (fig. 36). The other was a centrocecal scotoma, either absolute or relative, with a 0.5° target (fig. 37). The scotomas were larger for colors than for white.

The diagnosis was optic atrophy secondary to nutritional deficiency. Treatment consisted of a high-vitamin, high-calorie diet, supplemented by the daily administration of 6 multivitamin capsules by mouth and 50 mg. of thiamine chloride and 10 mg. of riboflavin by the intramuscular route. At the end of 60 days of this treatment, a second examination showed no change in the eyes.

Variations in Ophthalmologic Findings

Although the case just described was typical in both course and findings, certain variations were observed which should be briefly mentioned.

1. Cornea.—Five patients had small corneal scars following corneal ulcers that occurred in 1942, and one had a complete leukoma following perforation of an ulcer suffered at that time. All other corneas were clear.

2. Disk.—The color of the disks varied from minimal pallor limited to the temporal area to almost complete pallor; the temporal pallor was mild in the majority of cases. The most striking feature of the examinations was the lack of correlation between visual acuity and the extent of optic atrophy.

3. Macula.—The macular area was normal in about 60 percent of the cases. In the remaining cases, the examination revealed macular mottling and loss of the foveal reflex.

4. Fields.—The central fields varied only in size and in the density of the scotomas present. Density was related to the severity of the condition.

5. Vision.—Vision varied from 20/40 to 1/200. The impairment was directly related to the density of the scotoma present.

COMMENT

The group of patients presented in this report had an unusual and extremely unfortunate experience. They lived under conditions of malnutrition and

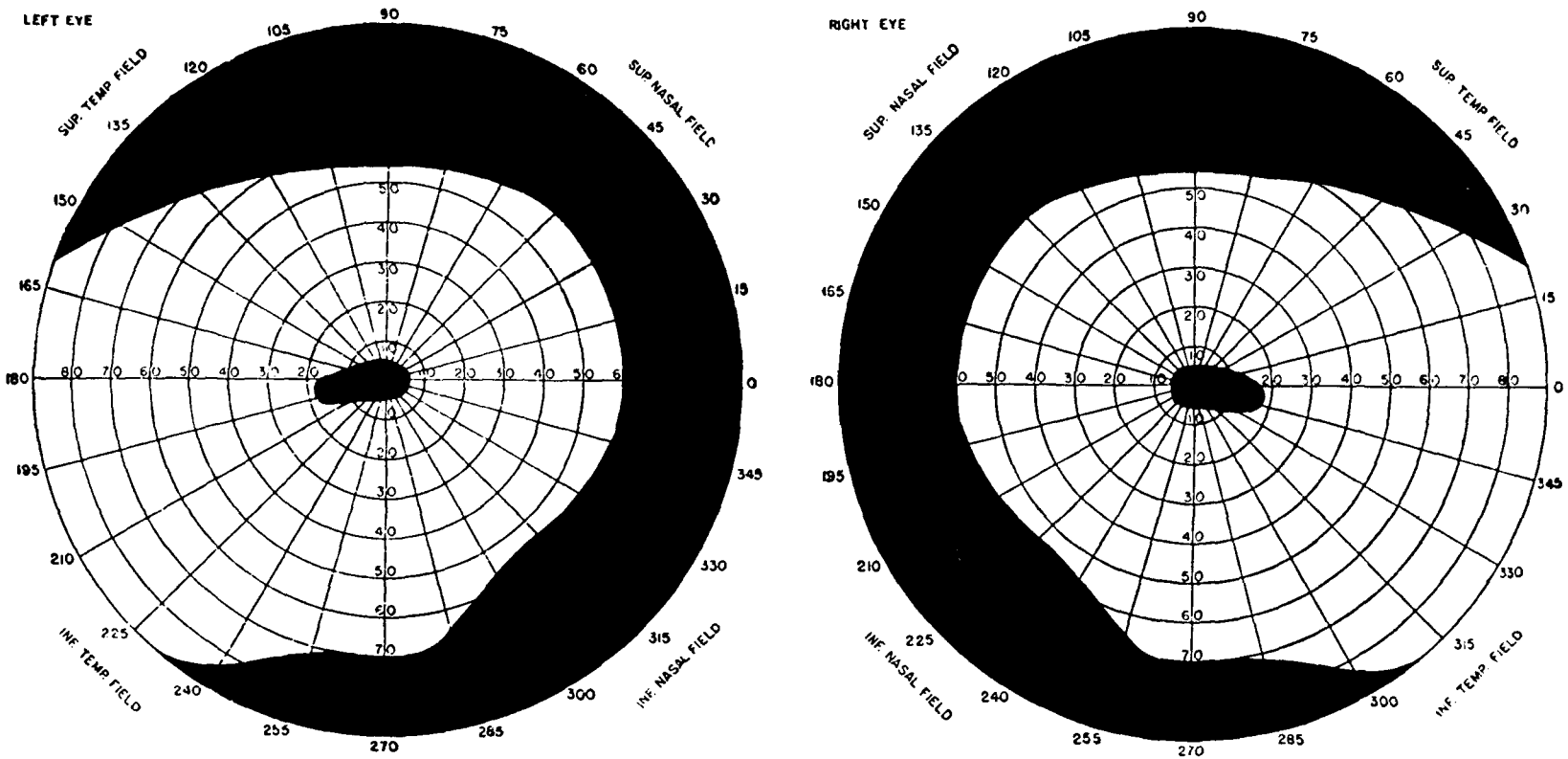


FIGURE 37. Central fields showing centrocecal scotoma with 0.5° target.

avitaminosis over long periods of time, during which they suffered severe loss of weight, extreme weakness, and symptoms of various diseases resulting from lack of food and of vitamins. After liberation, at the end of almost 3 years, they were given diets high in calories and rich in vitamins, with the result that all symptoms disappeared except those referable to the nerves and the eyes.

Numerous factors influenced the amount of final vision retained (table 6). A most important consideration is that the prisoners who suffered most severely from malnutrition did not survive, so that the patients who were finally observed at the eye center in the Zone of Interior represented the less severe cases. In this group, the men captured at Bataan seemed to have suffered more than the men captured at Corregidor, apparently because of the lack of supplies for the forces at Bataan before their capture. Their histories revealed that they had presented clear-cut signs and symptoms of malnutrition and early beriberi before surrendering, but there were then no symptoms referable to the eyes as far as could be determined.

The diets at the various prison camps played a paramount role in determining the end result. At Bilibid and Cabanatuan, the diets were most deficient. The daily ration from May to November 1942 consisted of from 200 to 400 gm. of polished rice, with watery soup made from cancong weed. Even when small amounts of other vegetables, fruit, fish, and meat were added, the quantities were too small to be of much value, and the diets were always far from adequate. The result was that at these camps the prisoners showed the most marked pathologic changes.

At the other extreme, prisoners at some camps in the southern portion of Japan proper showed much less marked changes, undoubtedly because their diets were more frequently supplemented with fish, fresh fruit, and even meat. Three patients with normal eye findings (who are not included in this report) were imprisoned in camps in which the diet approached normal.

In most camps, the rice served was polished. In one known instance, the rice polisher broke, and unpolished rice had to be served for 2 months. During this period, there was a notable improvement in the health of the prisoners, though deterioration and recurrence of symptoms were observed when the rations of polished rice were resumed. Inquiry revealed that prisoners who refused to eat the cancong soup and those who bartered their food for cigarettes suffered more severely than others.

Another important factor in the condition of the liberated prisoners was the presence of such diseases as malaria, dengue fever, and bacillary and amebic dysentery, frequently in severe forms. These diseases caused much debility and anorexia, which often prevented the ingestion of such food as was available.

Whenever it was possible to supplement the prison diet with vitamins, temporary improvement followed. The most striking improvement occurred when the prisoners received small amounts of the supply of vitamins sent to the camps by the American Red Cross in December 1943. Changes in the

eye were not affected by thiamine chloride given to liberated prisoners, probably because the patients had been thiamine deficient for so long that irreversible changes had taken place in the optic nerve. The peripheral neuritis was also not relieved, probably for the same reason. Some patients, not included in this report because they were not blinded, improved under thiamine therapy given parenterally in the early stages of the condition, but sufficient amounts were not available to give to all prisoners.

The obvious cause of the amblyopia from which these prisoners suffered was a thiamine deficiency. Polished rice is low in thiamine (each gram contains from a trace to 0.5 micrograms), and the cancong soup contained only a negligible amount. The total caloric intake per day was probably 900 to 1,600 calories, 200 to 400 gm. of rice furnishing approximately 700 to 1,400 caloric

Not only was the caloric intake low, but the ratio between the thiamine ingested and the total amount of calories consumed was also abnormally low. Cowgill,[1] in 1934, showed that a definite relationship should exist between the total caloric intake and the thiamine ingested and pointed out that, when the ratio is not normal, symptoms of deficiency could be expected to occur. Still another consideration, pointed out by Gordon and Sevringhaus,[2] is that the thiamine requirement of man is dependent on the proportion of fat to carbohydrate in the diet; fat has a thiamine-sparing action, while carbohydrate increases the need for thiamine. The need for thiamine in the diet given these prisoners was obvious, since rice contains 79.3 percent carbohydrate, 0.26 percent fat, and 7.1 percent protein.

Williams, Mason, Smith, and Wilder,[3] at the Mayo Clinic in 1942, studied the requirements of thiamine in man. The conclusions were that the minimal daily requirement of thiamine for man is between 0.22 and 0.50 mg. per thousand calories, provided that the ratio of carbohydrate to fat is normal. With an intake of 0.7 mg. of thiamine per thousand calories, patients lose weight and suffer from increasing weakness. As has been pointed out, these prisoners of the Japanese not only had an insufficient thiamine intake but also had an abnormal thiamine-calorie ratio and an abnormal ratio of carbohydrate to fat in the diet, so that their thiamine requirement was greatly increased.

Attention should be called to the similarity between the observations in these cases and those reported by Johnson [4] and by Carroll [5] in cases of tobacco-alcohol amblyopia which they considered due to thiamine deficiency. In amblyopia of both origins, the characteristic findings are defective vision, the

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[1] Cowgill, G. R.: Vitamin B Requirement of Man. New Haven: Yale University Press, 1934.

[2] Gordon, E. S., and Sevringhaus, E. L.: Vitamin Therapy in General Practice. 2d ed. Chicago: The Year Book Publishers, Inc., 1942.

[3] Williams, R. D., Mason, H. L., Smith, B. F., and Wilder, R. M.: Induced Thiamine (Vitamin B$_1$) Deficiency and the Thiamine Requirement of Man. Arch. Int. Med. 69: 721-738, May 1942.

[4] Johnson, L. V.: Alcohol-Tobacco (Toxic) Amblyopia Treated With Thiamin Chloride. Arch. Ophth. 21: 902-903, April 1939.

[5] Carroll, F. D.: (1) The Etiology and Treatment of Tobacco-Alcohol Amblyopia. Am. J. Ophth. 27: 713-725, July 1944. (2) Recurrence of Tobacco-Alcohol Amblyopia. Am. J. Ophth. 28: 636-639, June 1945.

presence of central or centrocecal scotomas, and temporal pallor of the optic-nerve head, with normal peripheral fields. Carroll, in 1944, suggested that the amblyopia observed in his cases either could be a manifestation of a deficiency condition without toxic elements or could be explained by the toxic effects of tobacco on malnourished cells. In this same communication, he suggested that when B_1 is added to the diet, the nutrition of the damaged cells, or perhaps of their axons, so improves that the injurious agent is no longer injurious. He also reported improvement in both vision and fields following the administration of thiamine. The observations on the prisoners reported in this chapter are in accord with Carroll's first postulate, since no toxic element seems to have been concerned with the pathologic changes. In a later (1945) publication, Carroll reported a case in which the ophthalmologic findings were practically identical to those which were observed in these prisoners and in which unquestionable improvement followed thiamine therapy.

Moore,[6] in 1937, described a syndrome observed among African sugar-plantation workers whose diet was extremely deficient. Many of the symptoms and signs, which included misty vision, photophobia, optic atrophy, glossitis, perlèche, itching and scaling of the scrotum, and neuritic changes, closely resembled those presented by these prisoners in the early stages of their disease. The end results in his patients also resembled those of these prisoners. Pellagra and ariboflavinosis cleared under treatment, but vision remained unimproved and the symptoms of peripheral neuritis persisted.

It is of possible importance that the prisoners claimed that their vision was better in dim light and in the evening than in ordinary daylight. This is contrary to what would be expected in vitamin A deficiency. Adequate amounts of cod liver oil were administered, but the treatment failed to arrest the impairment of vision, which suggests that some other factor was responsible. It did, however, result in healing of the corneal ulcers. Photophobia, lacrimation, and central scotomas were responsible for the poor vision in bright light, but at night, the uninvolved retina would be expected to function more or less normally.

CONCLUSIONS

Observations of initial changes in the eyes of American soldiers held in Japanese prison camps for almost 3 years and of residual findings after their liberation permit the following conclusions:

1. Malnutrition, as the result of a deficient diet, can cause optic atrophy manifested by defective vision, central or centrocecal scotomas, and pallor of the nerve head.

2. The deficiency in these cases was lack of vitamin B_1. The diet was highly deficient in thiamine, the optic changes were coincidental with the

[6] Moore, D. G. F.: Retrobulbar Neuritis cum Avitaminosis Followed by Postpartial Optic Atrophy—Now Shown to be of Pellagrinous Origin. Its Serious Incidence and Its Need for General Investigation. West African M. J. 9: 35–40, June 1937.

presence of beriberi,[7] and the administration of thiamine in the early stages of the deficiency resulted in relief of symptoms.

3. Treatment, to be effective, must be instituted early. Otherwise, the condition becomes irreversible, as evidenced by the lack of improvement following intensive vitamin therapy after the prisoners had been liberated.

4. The appearance of the disk varied from minimal to complete atrophy, the vast majority of eyes showing only a mild temporal pallor. The macula appeared normal in 60 percent of the cases and in the remainder showed mottling, with loss of the foveal reflex. The loss of vision and the size of the central scotomas were not directly proportionate to the amount of optic atrophy present.

5. The nerve involvements—peripheral neuritis and optic atrophy—were the only residual abnormalities evident in patients who had suffered severe malnutrition over a period of almost 3 years.

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[7] Vail in 1947 (Am. J. Ophth. 30: 220-222, February 1947) reviewed the history of nutritional amblyopia and commented that it makes bitter reading now, since it was in Japan that amblyopia and central scotoma due to beriberi were first observed and reported. "That ophthalmologists in Japan did not use their knowledge," he concluded, "is the crime of them all."

CHAPTER XVI

Dark-Adaptation Studies on Night Blindness in Military Personnel

Francis W. Parker, Jr., M. D.

Night blindness or poor night vision, which was a fairly common complaint among patients seen by ophthalmologists in the Mediterranean Theater of Operations in World War II, constituted a considerable diagnostic and therapeutic problem. For this reason, a special study of the condition was carried out on a group of United States Army personnel during the summer of 1944.

MATERIAL AND METHODS

Material.—The clinical material for this study consisted of 66 soldiers, divided into the following groups:

1. Fourteen apparently normal subjects, who served as controls. Most of them were infantrymen who had been on frequent night patrols or soldiers whose duties involved driving in blackouts. These men had no history of nocturnal visual difficulties and were positive in their denials that they had ever suffered from them.

2. Thirty-nine patients hospitalized with a diagnosis of nocturnal amblyopia, all of whom complained of night blindness.

3. Thirteen patients hospitalized for infectious hepatitis. These patients were included in the study because interest had been stimulated in the possible relationship between this condition and night blindness when nocturnal difficulties of vision appeared in an officer with hepatitis about 6 weeks after the onset of the hepatic disease.

Methods.—The ophthalmologic examination carried out on all patients included tests of visual acuity, cycloplegic refraction, funduscopic study, examination with the slit lamp, and studies of the central and peripheral fields. When these tests have been completed, the initial dark-adaptation test was done. If the first determination resulted in a low reading, neuropsychiatric examination was requested.

Dark-adaptation tests were carried out after preliminary bleaching of the visual purple, which was accomplished by having the soldier gaze at a well-illuminated white sheet for 10 minutes. He was then seated in a darkened room

1 meter in front of a Nagel adaptometer.[1] Readings of dark adaptation were taken at 1, 15, 30, and 45 minutes, the patient being instructed to keep his eyes closed between readings. Findings were plotted on a semilogarithmic scale in Nagel units, a Nagel unit being the reciprocal of the 1-meter Hoeffner candle. No correction was made for pupillary size.[2]

Final normal readings on the Nagel adaptometer range from 50,000 to 150,000 Nagel units after 45 minutes of dark adaptation. In general, all readings taken at 1 minute can be disregarded. They could be disregarded in this series for two reasons: (1) Following bleaching, visual-purple regeneration in the rods is negligible for several minutes, during which time dark adaptation is primarily the result of regeneration of iodopsin, a substance in the cones; and (2) patients were tested in groups of three, so that by the time the initial reading had been made on the third patient, a period of 2 or 3 minutes had already elapsed.

Secondary adaptation is accomplished by rhodopsin, a photosensitive pigment formed in the pigmented epithelium of the retina by a combination of

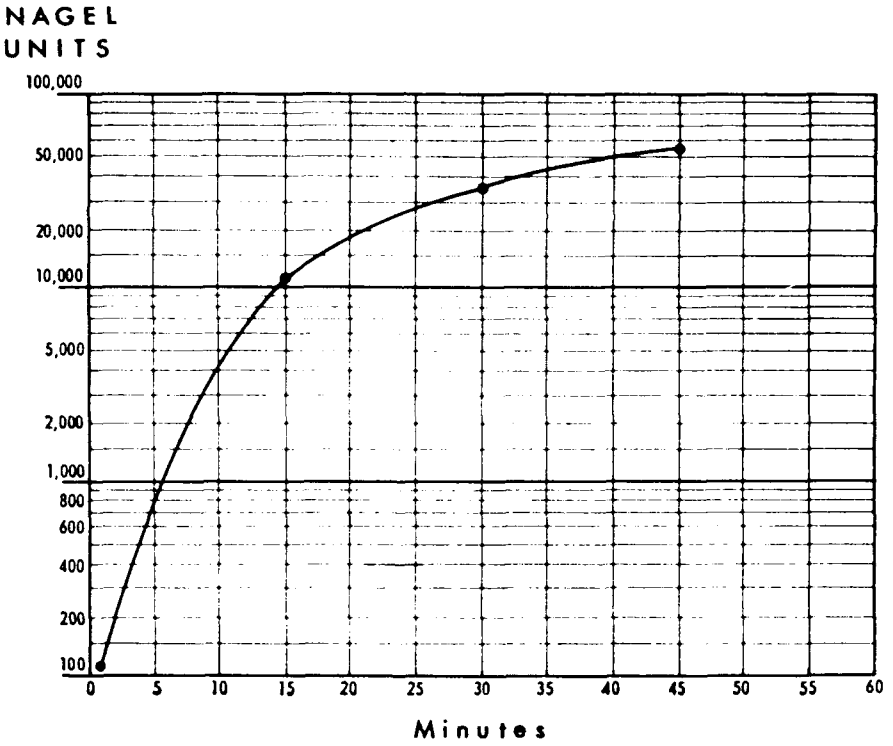


FIGURE 38. Dark-adaptation curve of normal subject. Cycloplegic refraction: Right +0.25 +0.75 CX 90, 20/16; left +0.75 CX 80, 20/16.

[1] The equipment used in this study was supplied by the Department of Ophthalmology at the University of Rome. Generous help was given by members of the university faculty, especially Prof. Giambattista Bietti, then on leave from the University of Sassari, Sardinia.

[2] Sloan, L. L.: Instruments and Technics for Clinical Testing of Light Sense. Arch. Ophth. 24: 258, August 1940

protein and vitamin A. Regeneration of rhodopsin is fairly rapid for the first 30 minutes but is not complete until 45 or 60 minutes have elapsed. Then, for all practical purposes, a maximum of light sensitivity has been reached.

When readings of dark adaptation taken at 1, 15, 30, and 45 minutes on the Nagel adaptometer are plotted on a semilogarithmic scale, the result is a simple curve with its convexity upward (fig. 38). It is obvious that, no matter what the degree of night blindness, a curve of this family will result when readings are made at the same intervals, since the curve represents the physiologic regeneration of visual purple, which is progressive until a maximum is reached.

CONTROL GROUP

Visual acuity in the control group of subjects was always 20/20 or better corrected. No patient in it showed a refractive error of more than 1.00 diopter under homatropine cycloplegia. Examination with the slit lamp, funduscopic examination, and studies of the visual field revealed no abnormalities. All determinations of dark adaptation were within normal limits (fig. 38).

PATIENTS WITH COMPLAINTS OF NIGHT BLINDNESS

Moderate Night Blindness

Five of the thirty-nine patients who complained of night blindness thought their visual difficulties at night were of moderate degree and were not incapacitating. The other 34 regarded them as of such severity as to make them of little or no use for frontline duty.

Three of the five patients who complained of only moderate difficulties presented refractive errors of 1.50 diopters or more. Corrected visual acuity was 20/30 or better in all. Examination with the slit lamp, funduscopic examination, and studies of the visual fields revealed no abnormalities in any of these patients. All had normal dark-adaptation curves. All were returned to full duty. The negative results of the examinations and the reassurance gained from them were apparently sufficient to convince the patients that their fears about their night vision were without basis.

Severe Night Blindness

The remaining 34 patients, all of whom complained of severe night blindness, fell into 4 groups, as follows:

1. Six patients had normal adaptation curves on the initial reading. Three of the six had a refractive error of 1.50 diopters or more, but corrected visual acuity was 20/30 or better in all cases. Examination with the slit lamp, funduscopic study, and examination of the visual fields revealed no abnormalities in any instance.

Additional investigation of this group of patients brought to light that each one had had some experience which convinced him that his night vision was inadequate. These experiences were, in effect, emotional traumas. Sometimes they had been repeated. Some had been of considerable severity. In every instance, the soldier felt that he had failed in a specific job, and he attributed his failure to his poor night vision.

A typical experience was about as follows: A soldier was on a night patrol on which a number of men had been lost. When he reviewed the experience, he attached great importance to the reactions and remarks of other members of the patrol. If he had been in charge, he was inclined to magnify these reactions and remarks because of his sense of responsibility for the loss of his comrades. His personal reaction would be to seek for some physical disability upon which to pin the responsibility for whatever he had done or failed to do, and vision, because of its obvious importance, was naturally one of the first physical capabilities to come under scrutiny. Men on frontline duty frequently discussed what they were able to see, and the observation that another man's vision at night was better than his own might increase the soldier's belief that his own was below standard, even though it was normal and the comparative difference was merely one of degree. The soldier also would not realize that he might not be using his eyes correctly. Not all soldiers were specifically taught how to use their eyes at night, and many of them attempted to fix objects on the fovea, where vision is poorest.

The six patients in this group were easily disposed of, all being returned to full duty. It was explained to them that their dark adaptation had been found to be normal (fig. 39), and they were given a few instructions on how to use their eyes at night. In particular, they were instructed to use a searching movement to discern objects in the dark and to look slightly to one side of an object, rather than directly at it, for best detail.

2. Five of the remaining twenty-eight patients, all of whom had initial low readings, had subnormal final readings for which no cause could be found. Their dark-adaptation curves followed the normal configuration; that is, they were simple curves, with the convexity upward. Only 2 of the 5, both of whom were myopic, showed refractive errors of more than 1.00 diopter. Corrected central vision in all five cases was 20/20 or better. Examination with the slit lamp revealed no pathologic changes, nor did funduscopic studies or studies of the visual fields reveal any abnormalities. Neuropsychiatric consultation showed all five soldiers to be stable individuals. No improvement followed the daily administration of 40,000 units of vitamin A in two cases.

Although no family history of night blindness could be elicited in any of these cases, it was finally concluded that all five of the patients probably presented the type of simple night blindness which may be hereditary. According to Duke-Elder,[3] night blindness in hereditary transmission exhibits

[3] Duke-Elder, W. S.: Text-book of Ophthalmology. St. Louis: C. V. Mosby Co., 1938.

(1) a dominant form; (2) a recessive form frequently associated with myopia; and (3) a recessive sex-linked form, usually associated with high-grade myopia and transmitted through unaffected daughters of affected males to some of their sons. Since a study of members of the family was impossible in these cases, it could not be determined, if the theory of hereditary night blindness was correct, to which of these groups the soldiers in question belonged.

3. Four of the remaining twenty-three patients with initial low final readings had dark-adaptation curves which followed the normal configuration

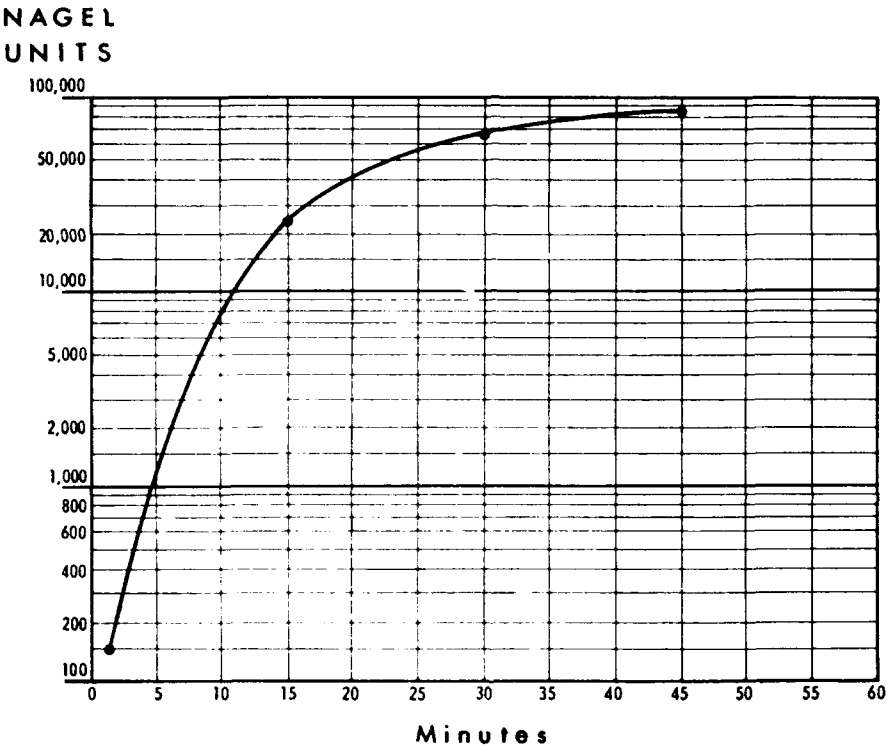


FIGURE 39.—Essentially normal dark-adaptation curve. Vision in both eyes 20/100. Cycioplegic refraction: Right −3.00 +2.25 CX 05, 20/20; left −3.00 +1.25 CX 160, 20/20. This patient was relieved as a tank driver and reduced from sergeant to private for sideswiping an oncoming truck at night. The officer who reduced him asked that he be hospitalized for night blindness. He was later returned to full duty.

(fig. 40A). On funduscopic examination, however, all were found to have retinitis with pigmentary degeneration, and two also had associated lenticular changes. Examination of the visual fields in all four patients showed extreme constriction of the peripheral field for form (fig. 40B).

These findings were not unexpected. Since visual purple is a component of the rod cells, which are more concentrated in the periphery of the retina, diseases of this region and disturbances of the pigment in which resynthesis appears to take place would cause a decrease in light sensitivity. Regeneration,

however, would not be altered in unaffected areas, which explains why the dark-adaptation curve in these cases followed the normal configuration.

4. In the remaining 19 cases, it was not possible to explain the extremely low adaptation readings by funduscopic changes or on the basis of heredity or of dietary factors. Twelve of the nineteen had refractive errors of more than ±1.50 diopters, and eleven had corrected visual acuity of less than 20/40. Funduscopic study revealed no gross pathologic changes. Examination of the visual fields revealed a variety of findings. Some fields were normal.

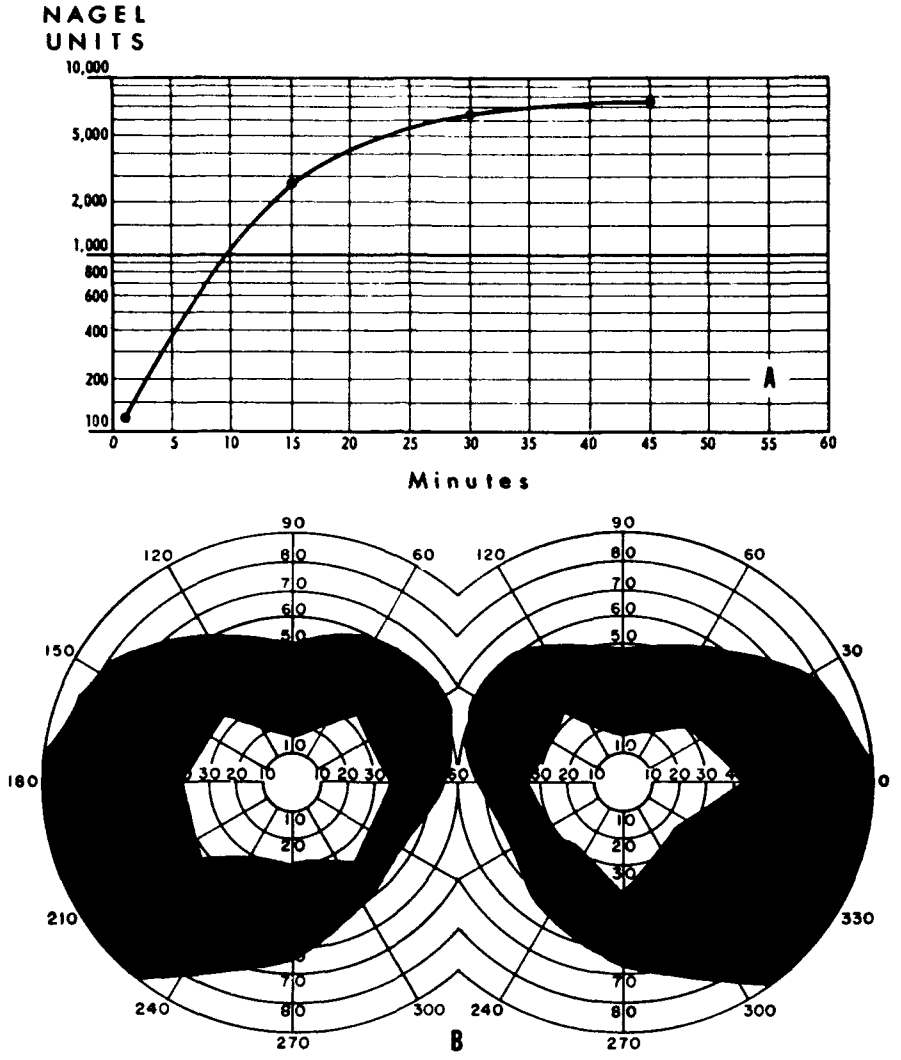


FIGURE 40.—A. Dark-adaptation curve in patient with vision in both eyes 20/40 −2. Cycloplegic refraction: Right −0.50 −0.50 CX 160, 20/20; left −0.50 −1.25 CX 130, 20/20. B. Visual fields showing extreme peripheral constriction. Examination with 2-mm. test object at 1-meter distance. Primary pigmentary degeneration of the retina and attenuation of the retinal arteries.

Others showed peripheral constriction of from 10° to 30°. Very irregular fields, however, were not frequent.

Five of these nineteen patients not only had low final readings but their dark-adaptation curves also showed abnormal configurations.

The findings in these 19 cases did not lend themselves readily to explanation. Some patients, it is true, had histories suggestive of psychoneurosis, but it was obviously difficult to establish night blindness as a hysterical manifestation, and it was also necessary to explain the abnormal configuration of the curves of dark adaptation present in some cases.

The first step was to recheck the dark-adaptation studies in this group. When this was done, valuable information was secured, the cases falling into two distinct classes. For the most part, the 14 patients who showed an initial curve of normal configuration showed, on the second examination, a curve of the same family, although the final reading was often such as to preclude the probability of range of error. The five patients whose initial curves were abnormal did not show consistent findings on the second examination in either the configuration of the curves or the final readings.

When this group of 19 patients was divided into 2 subgroups on the basis of the type of curve revealed on the recheck of dark adaptation, it became evident that the curves of abnormal configuration in the group of 5 patients were so inconsistent as to make it conceivable that the patients were willfully misinterpreting the readings. The findings in the other 14 patients, who presented low readings but had curves of normal configuration, could reasonably be explained by a suppression of dark adaptation.

The inconsistency of the abnormal curves in 5 of these 19 cases could be explained by willful misinterpretation or malingering. This could be accomplished in the dark-adaptation test by the giving of inaccurate answers. It would be difficult, however, to achieve similar readings at an interval of a week, and it would be a matter of chance if a normal configuration curve of dark adaptation were produced by plotting the results. In the other 14 patients, who had normal curves but low readings, hysteria seemed the logical explanation. Since hysterical suppression of dark adaptation occurs at an unconscious level, it would occur equally in all readings, and the curve, although low, would be of normal configuration. Many of these 14 patients presented such manifestations of psychoneurosis as hysterical amblyopia and regular constriction of the peripheral form fields.

Additional testing.—The division of the 19 patients with unexplained, extremely low adaptation readings into these 2 categories made it possible to apply a test to confirm the belief that 1 group of 5 patients was deliberately misinterpreting the readings. This test was carried out with the opticokinetic drum, by a method long in use in the Medical Corps of the Italian Army for the detection of soldiers feigning blindness.

An electrically driven opticokinetic drum, about 24 inches in diameter and about 18 inches high, was constructed by Prof. G. Bietti of the Polyclinic

Hospital in Rome. Alternate stripes of black and white paper were pasted on it vertically. The Nagel adaptometer was then set so as to throw the light on the drum. After one of the subject's eyes had been anesthetized, a special contact lens was placed over the cornea. The posterior surface of this lens was painted black, and a small piece of radium paint from a watch dial was fastened securely on the center of the anterior surface, so that any movement of the open eye could be followed in a darkened room.

The patient, instructed to open both eyes and gaze directly ahead, was seated in front of the opticokinetic drum, which was rotated slowly as the light from the adaptometer was increased in intensity. He was told to report as soon as he could distinguish any moving objects.

The principle of the test is simple: When a series of moving objects traverses the field of vision, the eyes follow one object until its successor obtrudes itself into the consciousness. When this occurs, the fixation reflex comes into play, and the second object is fixated. The type of nystagmus commonly known as opticokinetic (train nystagmus) is thus produced. Since the nystagmus is involuntary, the test is absolute as soon as the patient can discern the moving objects.

Among these 19 patients, the 14 who had normal configuration curves of dark adaptation reported seeing the drum as soon as the nystagmus developed. The five who had abnormal curves exhibited nystagmus long before they reported seeing the drum. Sufficient evidence was thus obtained to make it possible to stress to the patients in this subgroup the results of the test and the seriousness of malingering. When new dark-adaptation determinations were made, all five patients who initially showed abnormal configuration curves now presented normal curves (fig. 41).

The 14 patients who had curves of dark adaptation of normal configuration but of low levels were referred to the neuropsychiatric department for both diagnosis and therapy. In every instance, a diagnosis of psychoneurosis was made. All of them showed marked improvement when final determinations were made after psychotherapy (fig. 42) and also showed marked improvement in associated hysterical manifestations such as amblyopia and constriction of the peripheral fields for form.

Comment.—The categories of hysteria and malingering were found to be not at all rigid. In both states, it is established that the patient is attempting escape from an undesirable situation. Both states are motivated by fear. Most of the patients in both groups in this series were from combat organizations, where fear of death was constant. A person with a desire to escape an unpleasant situation may consciously feign a physical defect and, unless detected, will continue to do so until the danger is removed. In the psychoneurotic, the whole mechanism is at an unconscious level. Many of the patients in this category in this series had poor vision and high refractive error or were doing work for which their eyes were all important. The unconscious was thus

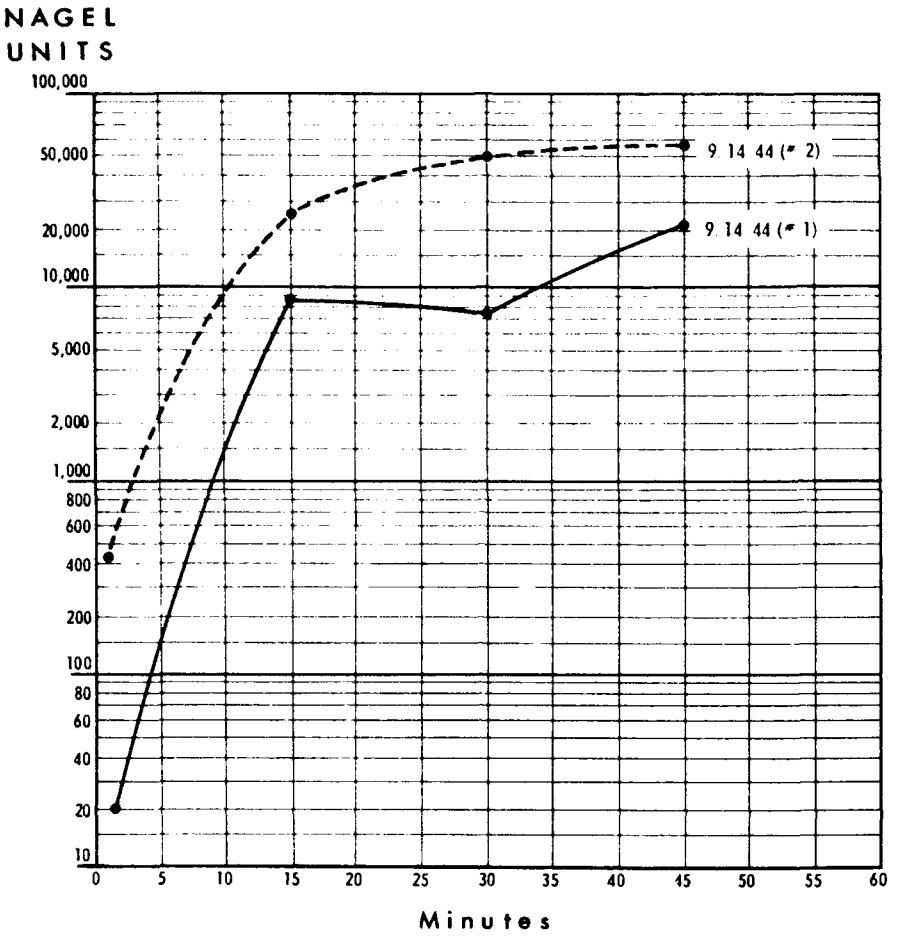


FIGURE 41.—Dark-adaptation curve. Patient was shown to be malingering by testing with the opticokinetic drum. Vision: Right 6/200; left 20/30. Cycloplegic refraction: Right +0.50 CX 90, 6/200; left +0.50 CX 90, 20/20. A dark-adaptation reading (#2) taken 2 hours after the first reading and after the patient had been confronted with the seriousness of malingering showed, in contrast to the first reading (#1), normal configuration of the curve and a normal final reading.

constantly being conditioned, and, once the situation became intolerable, escape was accomplished by way of visual disability. Moreover, as will be pointed out shortly, conditioning of an emotionally unstable individual can be produced merely by repeated ocular examinations.

Since, as already pointed out, both malingering and psychoneurosis are motivated by fear, the prospect of returning to the unpleasant situation is likely to produce a relapse. A malingerer who had been detected was not likely to attempt further escape by the same route, since he understood the consequences (fig. 43). On the other hand, examination of the eyes sometimes conditioned the malingerer, and a psychoneurosis sometimes developed when he

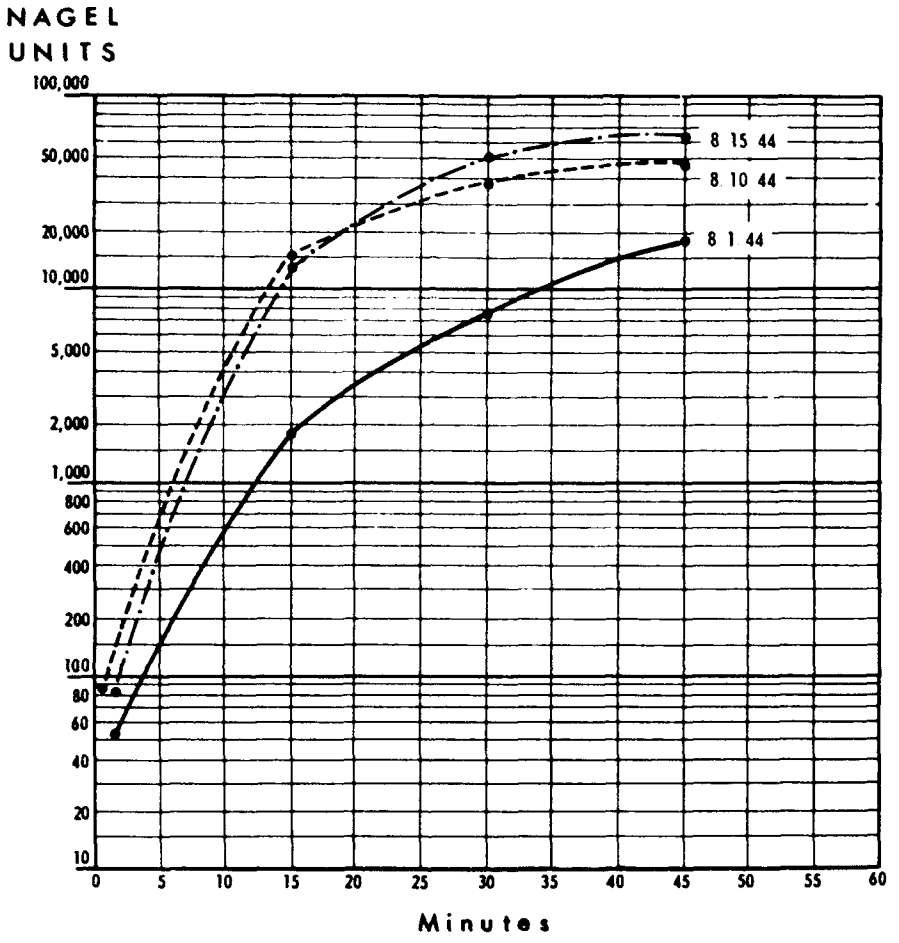


FIGURE 42.—Dark-adaptation curve in patient who had always had poor vision and who had noticed poor night vision, which had become progressively worse, since he had been overseas and had served as gun pointer in an antiaircraft battery. Vision: Right and left 20/50. Cycloplegic refraction: +0.50 S 20/50 in both eyes. The diagnosis in this case was psychoneurosis. The lowest final reading was made 1 August 1944, the next higher reading 10 August after psychotherapy, and the highest reading 15 August, the day before the patient was returned to full duty.

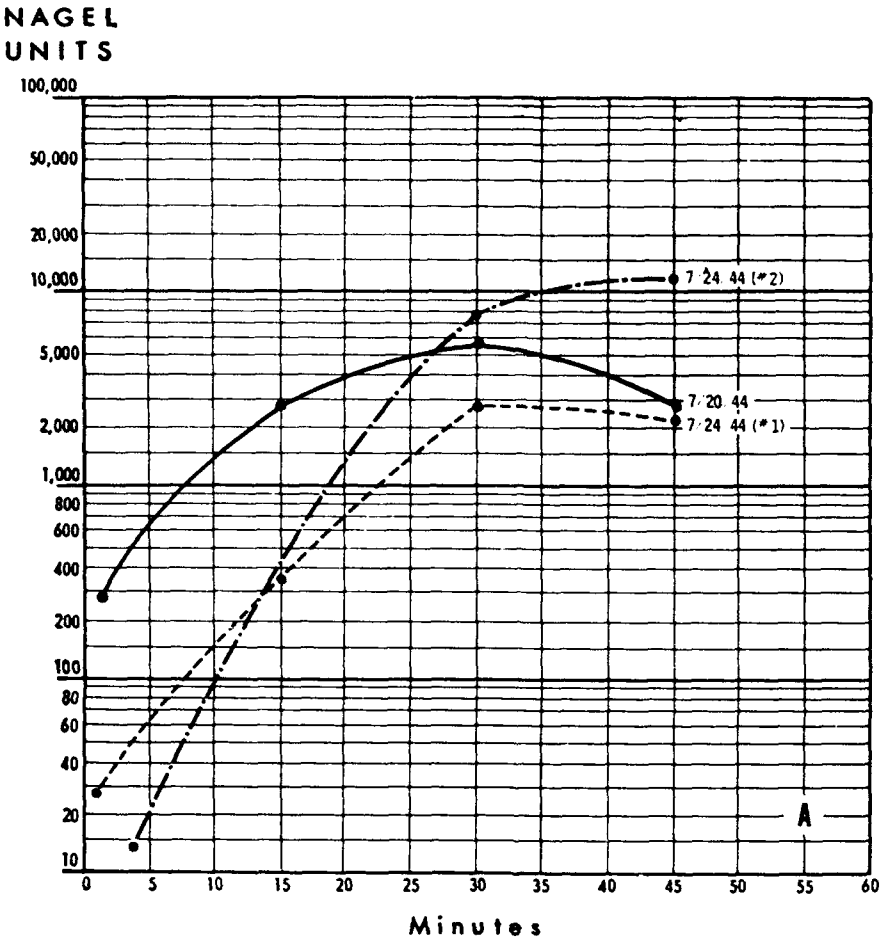


FIGURE 43.—A. Dark-adaptation curve in patient who had been on frontline duty for a week and had become completely incapacitated because of poor night vision. Vision 20/200 in both eyes. Cycloplegic refraction: right $-3.50+1.00$ CX 10, 20/30; left $-3.00+0.75$ CX 170, 20/40. Original dark-adaptation reading 20 July 1944 showed a normal configuration curve with low final reading. The second test, 24 July (#1), showed an even lower final reading. Two hours after the opticokinetic test had been positive for malingering and the patient had been confronted with the seriousness of his offense, the configuration curve (#2) was of normal shape, but the final reading was still abnormally low. A diagnosis of psychoneurosis was made by the neuropsychiatrist, and the patient was told that he would be returned to duty.

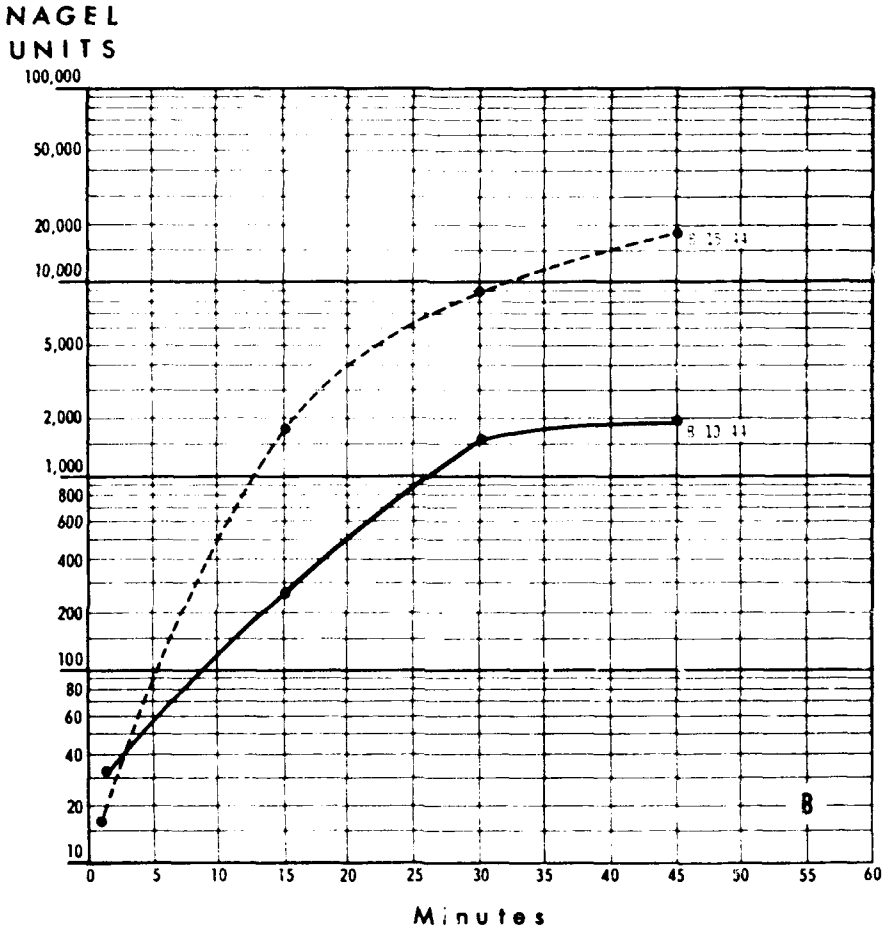


FIGURE 43.—Continued. B. The next reading on 10 August was lower than the reading made after the patient had been warned of the danger of malingering. The last reading was taken 15 August, after 5 days of treatment on the neuropsychiatric service. The patient was still quite tense, but was improving.

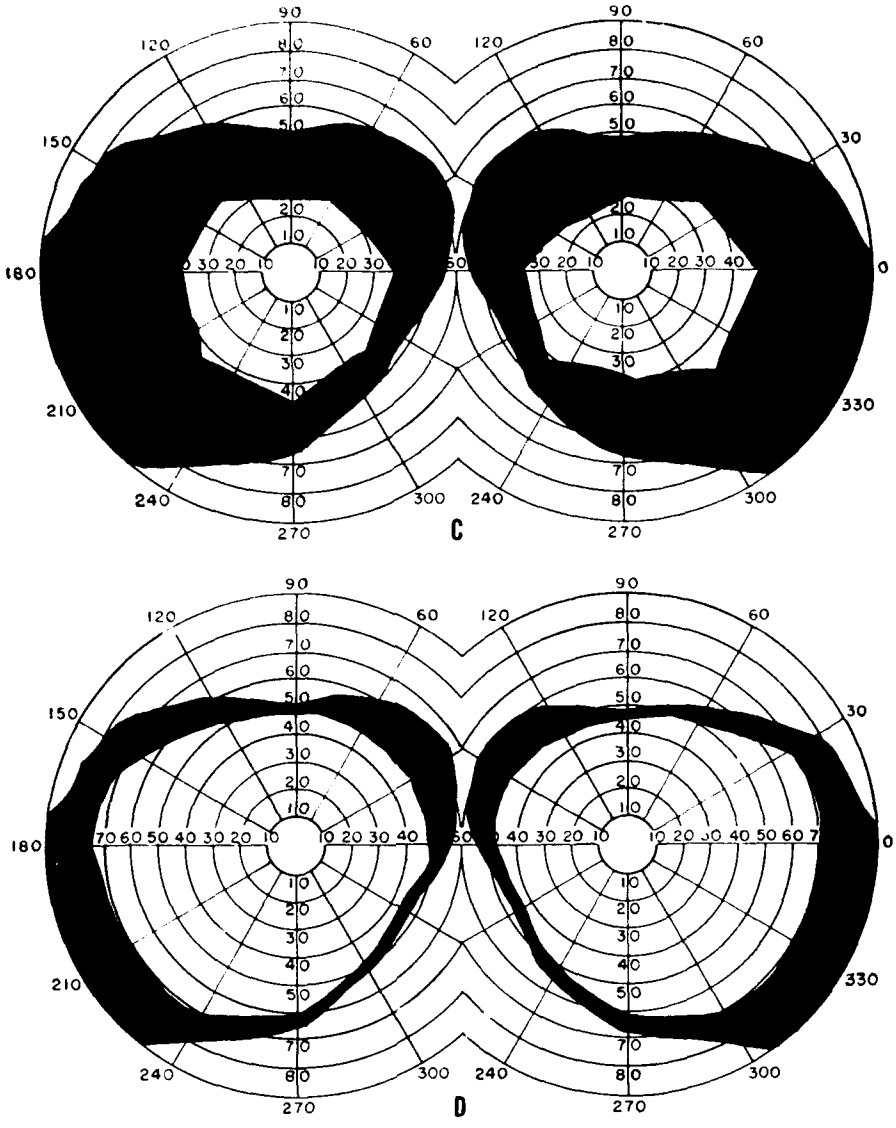


FIGURE 13. Continued. C and D. Peripheral fields. Note the difference in the fields taken 24 July (C) and 15 August (D), the latter after psychotherapy.

was faced with a return to duty. The psychoneurotic, in turn, once told that he was well enough to return to duty, sometimes, in desperation, attempted malingering.

Therapy. Psychotherapy consisted (1) of removing the undesirable situation and reassuring the patient and (2) of helping him to gain an insight into his condition by removing the motivating force and releasing the mechanism whereby the dark adaptation was suppressed. The degree of release depended as much on the intelligence and stability of the patient as on psychotherapy.

PATIENTS WITH INFECTIOUS HEPATITIS

It is important to point out, before entering upon a discussion of the group of patients with infectious hepatitis, that all patients hospitalized with this diagnosis were placed on a so-called hepatitis diet, which was low in vitamin A and carotene. Each received daily 2 multivitamin capsules, containing 5,000 units of vitamin A. Since no patient had acholic stools, it can be assumed that absorption was adequate.

One of the thirteen patients hospitalized for infectious hepatitis proved on complete medical workup not to have the disease. His visual acuity and visual fields were normal, and no abnormalities were found on complete ophthalmologic examination. The final reading on the first test for dark adaptation was 58,000 Nagel units. After he had been given 40,000 units of vitamin A daily for 2 weeks, the test was repeated and revealed a final dark-adaptation determination of 35,000 Nagel units. Neuropsychiatric consultation uncovered a psychoneurosis. At this time, the patient's complaint of upper abdominal distress was secondary to vague visual complaints.

All 12 patients had abnormal cephalin flocculation and bromsulfalein determinations during the period of hospitalization, and all but 3 had increased icterus indexes at some time during the hospital stay. The three patients who showed no increase in the index had histories of jaundice and dark urine prior to admission.

Six of the twelve patients who actually had infectious hepatitis had mild attacks and were all returned to full duty within 15 weeks or less of the onset of the disease. They presented no abnormalities on ophthalmologic examination, and all had normal dark-adaptation curves. The daily administration of 40,000 units of vitamin A to these patients produced an appreciable change in dark adaptation in only one case.

The other six patients, who had severe infectious hepatitis, also presented no abnormalities on ophthalmologic examination with one exception. This patient showed prominent corneal nerves on slit-lamp examination and seemed, on a crude sensitivity test, to have a mild corneal anesthesia. Four of the six had low final readings on the first testing for dark adaptation, though all had curves of normal configuration. The other two patients in this group, who also had normal curves, had normal readings on the first test for dark adaptation but subnormal readings when the test was repeated after an exacerbation of the hepatic disease. There was only a slight alteration in the results, however, when the test was repeated on two patients who developed jaundice during hospitalization, and the changes were well within the range of possible error (fig. 44).

All three patients with severe chronic infectious hepatitis and subnormal dark-adaptation determinations were given 40,000 units of vitamin A by mouth daily. They showed marked improvement in dark-adaptation curves within a week (figs. 45 and 46). One of the three had a final reading of 61,300

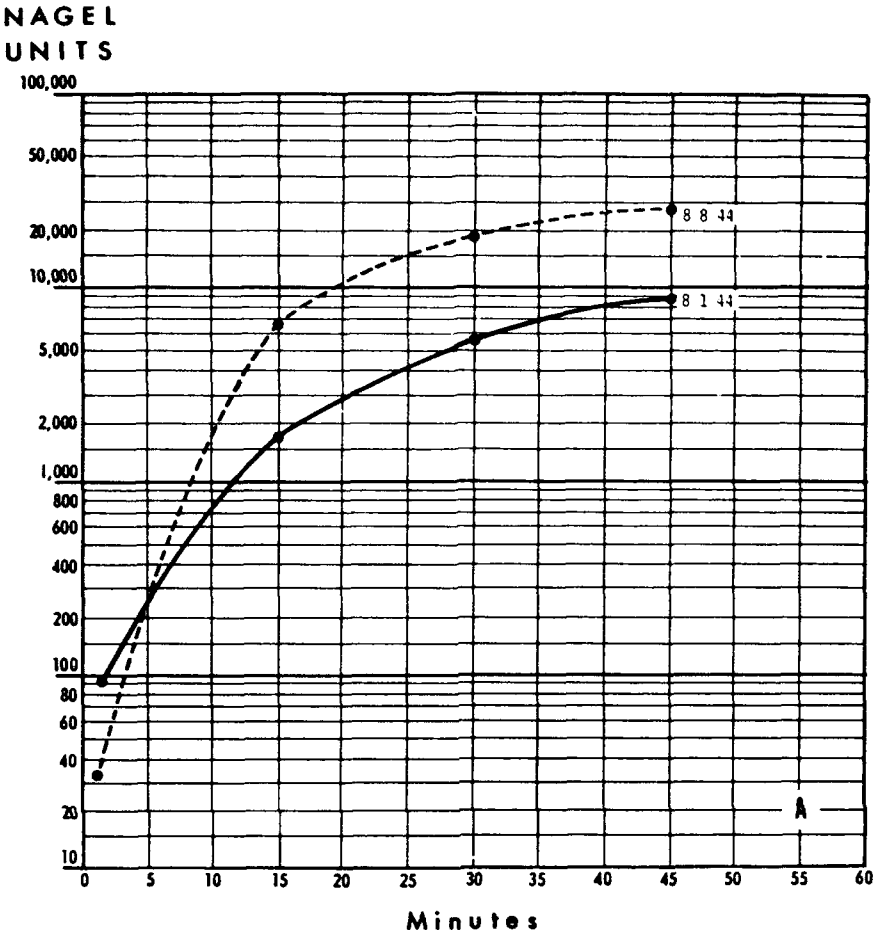


FIGURE 44.—A. Dark-adaptation curves in patient with severe infectious hepatitis. Vision: Right 6/200, left 4/200. Cycloplegic refraction: Right −2.25 +0.75 CX 120, 20/50; left −3.00 +1.50 CX 80, 20/50. In May 1944, the patient complained of anorexia, malaise, and generalized aches and pains. He was hospitalized for a wound in June. When he returned to duty, he noticed that at night he could not see the white tape used by engineers to mark off mine fields. For 2 weeks, he was led around at night by a sergeant. He was hospitalized again early in July for nausea, vomiting, and fever, and a diagnosis of hepatitis was made. The first (low final) reading was taken 1 August and the slightly higher reading 8 August, after the daily administration of 40,000 units of vitamin A.

Nagel units. Shortly afterward, he suffered an exacerbation of the hepatitis and was placed on absolute bed rest. Vitamin A therapy was continued, in the amount of 40,000 units daily. At the end of 3 weeks, when the patient was able to make the trip to the University of Rome for examination, the final reading in the dark-adaptation determination had fallen to 26,000.

Comment.—Although 4 of the 12 patients with proved infectious hepatitis had subnormal dark-adaptation determinations, corneal changes and evidence of vitamin A deficiency were not observed. One patient, as just mentioned,

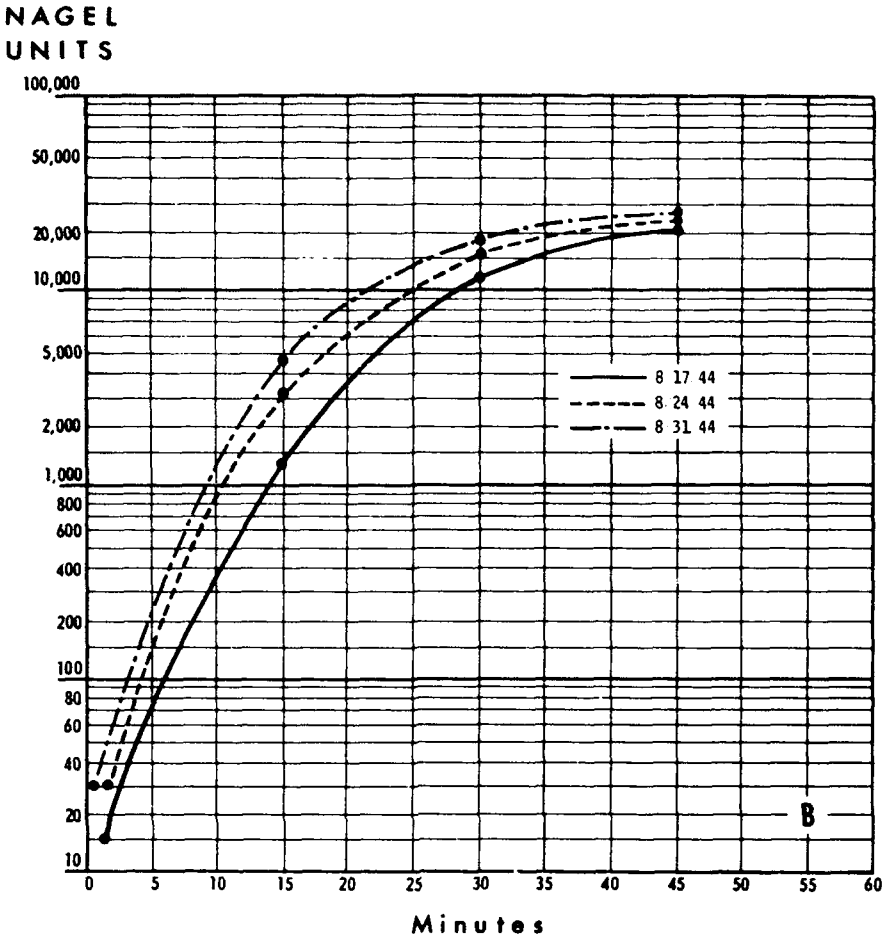


FIGURE 44.—Continued. B. The next readings were taken during an episode of jaundice (17 and 24 August), while vitamin therapy was still being given. While all final readings are much the same, the highest was taken 31 August, when the jaundice was receding and the icteric index was 4.

had prominent corneal nerves, but this is not an uncommon finding. As Gifford [4] has pointed out, when night blindness affects adults as the result of a vitamin A deficiency, the visual difficulty is usually noticed before corneal changes occur.

Dark adaptation is known to depend to some extent on the plasma level of vitamin A. This vitamin is transferred by way of the plasma from storage depots in the liver to the pigmented epithelium of the retina, where it is utilized in the resynthesis of rhodopsin, the photosensitive pigment in the rods. Investigations by Popper and his associates,[5] however, indicate that there is no relationship between the level of vitamin A in the plasma and the level in the

[4] Gifford, S. R.: A Textbook of Ophthalmology, 2d ed. Philadelphia: W. B. Saunders Co., 1941.

[5] Popper, H., Steigmann, F., Meyer, K. A., and Zevin, S. S.: Relation Between Hepatic and Plasma Concentration of Vitamin A in Human Beings. Arch. Int. Med. 72: 439–460, October 1943.

liver in patients with hepatic disease. These observers frequently found the plasma level zero in patients with disease of the liver, though on repeated examinations they were never able to demonstrate an absence of vitamin A in any human liver. In their opinion, vitamin A deficiency is more likely to be caused by a defect in the release of vitamin A from the liver than by a depletion of the storage depots.

Fluorescence studies, with comparisons of concentrations of vitamin A in the plasma and in the liver, furnished proof of this contention, as follows: Patients with disease of the liver had an abnormal distribution of vitamin A in the liver cells. Vitamin A fluorescence of hepatic tissue closely paralleled the vitamin A concentration in the liver, but only when vitamin A concentration in the plasma was high did the plasma concentration equal the liver concentration. When the vitamin A concentration in the plasma was low and the dis-

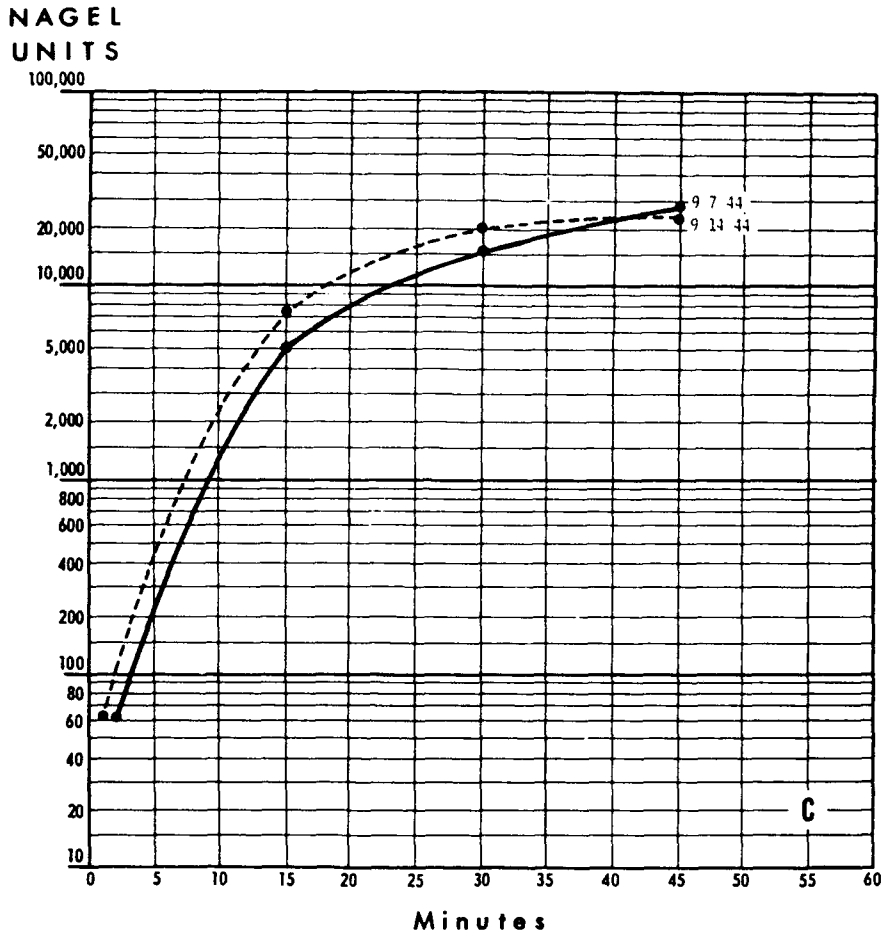


FIGURE 44.—Continued. C. Treatment was continued, and jaundice had disappeared when the next readings were taken, the last on 14 September. It should be noted that the final readings are still within the same range as the earliest readings (fig. 44A).

tribution of the vitamin in the liver was abnormal, the plasma level could be elevated by the administration of massive oral doses of vitamin A.

In the six cases in this series in which hepatitis was mild and did not become chronic, it can be assumed that the parenchymal damage was not sufficient seriously to affect the liver-plasma relationship of vitamin A concentration, since no patient in the group showed a significant improvement in light sensitivity after treatment with 40,000 units of vitamin A daily. In the six cases in which the hepatitis was severe, it can be assumed that parenchymal damage was sufficiently serious to cause an abnormal distribution of vitamin A and a deficiency in the release of vitamin A from the liver, since, after oral administration of vitamin A, all patients showed a marked increase in light sensitivity, as manifested by improved dark-adaptation readings.

That an acute exacerbation of hepatitis can further depress the vitamin A level of the plasma is demonstrated by the single case in the series in which,

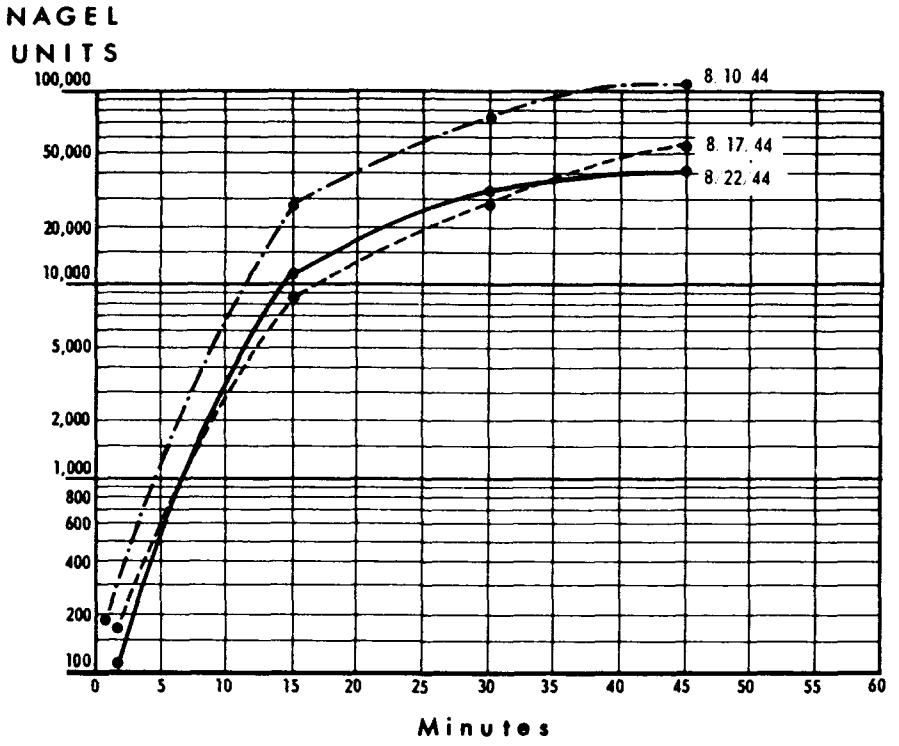


FIGURE 45.—Dark-adaptation curves of patient with hepatitis. Vision 20/20 both eyes. Ophthalmologic examination negative. Hepatitis developed 12 weeks before the first reading 10 August 1944. The liver was tender and was palpable three fingerbreadths below the costal margin. Liver-function tests were reported abnormal. Neuropsychiatric consultation was negative. Successive dark-adaptation determinations 17 August and 22 August after the daily administration of 40,000 units of vitamin A for 3 days and 9 days, respectively, showed improvement in the final readings. There was, however, no clinical improvement in the hepatitis, and liver-function tests continued abnormal

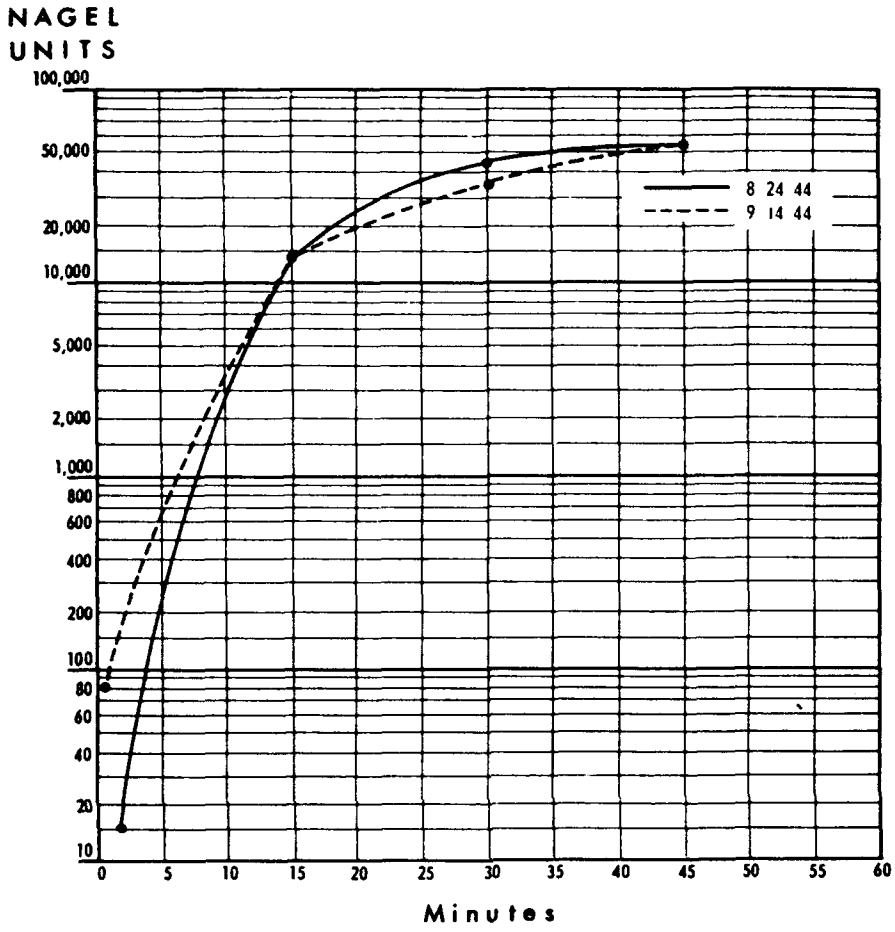


FIGURE 46.—Dark-adaptation curves of patient with hepatitis. Vision 20/70 in both eyes. Cycloplegic refraction: Right −1.50 +1.25 CX 180; left −2.00 +1.75 CX 180. The corneal nerves were prominent, and corneal sensitivity to the cotton test was decreased. Hepatitis developed in this patient 20 July 1944, and jaundice 27 July. The icterus index was 2, and there was no jaundice when the initial reading was made 24 August, but the liver was tender and palpable 2 fingers below the costal margin, and liver-function tests were abnormal. The second test was made 14 September, after the administration of vitamin A for 16 days, when liver-function tests were improving.

after such an exacerbation, dark adaptation was decreased, in spite of the fact that the patient was receiving 40,000 units of vitamin A daily. The train of events suggests a possible relationship between the degree of liver damage in a given case and the depression of release of vitamin A from the liver into the plasma. It may also account for the fact that another patient, who showed marked improvement in dark adaptation after being placed on vitamin A therapy, failed to attain a normal final reading, in spite of the fact that he had received 40,000 units daily for 8 weeks. The highest final reading after a week of treatment was 26,000 Nagel units, and the reading remained at the same level during the ensuing 7 weeks of treatment. Popper and his associates

gave doses as high as 75,000 units daily, and it would be interesting to know what larger doses might have accomplished in this special case.

It seems unlikely that jaundice per se alters visual-purple regeneration. Two patients in this series showed no appreciable changes in dark adaptation when it developed during the course of hospitalization.

The condition of the patient admitted with a diagnosis of hepatitis and with complaints of upper abdominal distress, who later proved to be psychoneurotic, is easily explained. His escape was blocked by the proof that he actually had no hepatic disease. When, therefore, he was faced with the necessity of returning to the front, he developed night blindness with vague visual complaints. Dark adaptation and other ocular examinations conditioned him and he tried to escape from an undesirable situation by the unconscious development of an ocular disability.

SUMMARY

Because night blindness or impaired night vision proved a considerable diagnostic and therapeutic problem in the Mediterranean Theater of Operations in World War II, a special study of the condition was carried out on 66 patients. Fourteen, who had no complaints referable to the eyes, served as controls. Thirty-nine complained of moderate to severe night blindness. Thirteen others had infectious hepatitis. Complete ophthalmologic examinations were carried out on all patients, and all were examined by means of Nagel's adaptometer for dark adaptation. Neuropsychiatric consultation was secured whenever it was indicated.

None of the 14 control patients had corrected central vision of less than 20/20 and none under homatropine cycloplegia had a refractive error of more that 1.00 diopter. All had normal dark-adaptation curves. Their final readings at the end of 45 minutes ranged from 50,000 to 150,000 Nagel units.

The 39 patients who complained of night blindness were divided into the following groups:

1. Five with moderate complaints had normal dark-adaptation curves. Of these, three had more than −1.50 diopters of astigmatism.

2. Six with severe complaints also had normal curves. Three had high myopic astigmatism. Detailed investigation of the patients in this group revealed in every instance some episode which had caused the patient to believe that his night vision was inadequate.

3. Five with severe complaints had initial low adaptation readings, for which no cause could be found. They were considered to have true simple night blindness.

4. Four with severe complaints had pathologic changes in the fundus.

5. Five with severe complaints were found to be malingerers. The suspicion was verified by means of a test which utilizes the principle of optico-kinetic nystagmus.

6. Fourteen proved to be neuropsychiatric.

Of the 19 patients with complaints of night blindness who proved to be malingerers or neuropsychiatric, 11 had corrected vision of 20/40 or less, and 12 had refractive errors of 1.50 diopters or more.

The 13 patients admitted with a diagnosis of infectious hepatitis fell into the following groups:

1. One was found on medical examination not to have hepatitis. Further investigation revealed a psychoneurosis.

2. Six with chronic hepatic disease showed subnormal dark adaptation. Three of these were given vitamin A by mouth with marked improvement.

3. Six patients whose disease did not become chronic and whose periods of hospitalization did not exceed 15 weeks had normal dark-adaptation curves. Little or no improvement was noted in any patient in this group when massive doses of vitamin A were administered.

CHAPTER XVII

Visual Disturbances Associated With Head Injuries

James N. Greear, Jr., M. D., and John S. McGavic, M. D.

HISTORICAL NOTE

Because experimental determination of visual-field defects induced by injury is not feasible, for obvious reasons, information concerning them must be derived from studies of cerebral lesions in human subjects who come either to operation or autopsy. From these studies, certain conclusions can be drawn concerning surviving patients who are not operated on. The large numbers of head injuries which occur in battle casualties provide unsurpassed material for the study of the representation of various areas of the retina in the cerebral cortex. As a matter of fact, few significant contributions to the subject have been made except during time of war.

Two significant articles on the subject of visual disturbances associated with head injuries were based on studies of British casualties in World War I. The first, by Holmes and Lister,[1] appeared in 1916, and the second, by Holmes,[2] appeared in 1918.

Henschen, in 1900, did the pioneer work in this field with pathologic studies which showed that the visual cortex lay in the occipital region. He also localized several areas as representing various portions of the retina. Inouye, in 1909, reported the effects of occipital-lobe injuries incurred in the Russo-Japanese War and pointed out that the macular center was at or near the occipital pole. Marie and Chatelin, in 1914, published studies on a similar series of cases. Riddoch's case reports, published in 1916, confirmed previous observations.

In 1918, in a paper dealing with occipital lesions, Moreau[3] discussed central-field defects. He divided the retina into three zones—a zone of fixation, a zone of distinction, and a zone of perception—and expressed the opinion that cortical representation was similarly divided. In the same year, Morax[4] differentiated the fixation and the macular area and stated that he

[1] Holmes, G. H., and Lister, W. T.: Disturbance of Vision From Cerebral Lesions. Brain 39: 34–73, June 1916.

[2] Holmes, G. H.: Disturbances of Vision by Cerebral Lesions. Brit. J. Ophth. 2: 353–384, July 1918.

[3] Moreau, F.: Sur les Troubles de la Vision Maculaire Produits par les Lésions Traumatiques de la Région Occipitale. Ann. d'ocul. 155: 357, 1918.

[4] Morax, V.: Discussion des Hypothèses Faites sur les Connexions Corticales des Faisceaux Maculaires. Ann. d'ocul. 156: 25, 1919.

had found the fixation area affected when both occipital lobes were injured, though they were not affected when the injury was unilateral.

ANATOMIC AND PHYSIOLOGIC CONSIDERATIONS

Head injuries which cause disturbances of the visual field involve the chiasm, the optic radiations, and the occipital cortex. The anatomy and physiology of the chiasmal fibers require no discussion. The geniculocalcarine pathway lies in the internal capsule, behind the sensory fibers and internal to the auditory fibers. Fibers from the upper retinal quadrants lie dorsally, and fibers from the lower retinal quadrants lie ventrally, with the macular fibers lying between these groups.

To the best of present knowledge, the visual cortex occupies the medial surface of the occipital lobes, extending from the occipital pole to the anterior end of the calcarine fissure. Posteriorly, the visual area extends for a small distance onto the lateral surface of each occipital lobe. This area is thought to include representation of the fixation area.

Opinion is divided whether there is bilateral cortical representation of the macular areas. The consensus, however, is that each cortical macular center represents half of each macula; that is, the left cortex represents the right half of each fixation area and vice versa. Since there is division of the fixation area of the field of both eyes when the entire occipital cortex is damaged on one side or the other, this opinion seems logical.

So-called sparing of the macula is the rule in vascular disease but is less frequent in traumatic lesions. Sparing of the entire fixation area is less often found when the central field is closely studied; division of the fixation area is rather frequent under these circumstances. There are three possible reasons for sparing of the fixation area: (1) Escape from involvement in the injury of this cortical area; (2) the double blood supply to the occipital cortex, consisting of the calcarine artery and the middle cerebral artery; and (3) the fact that patients may learn to use eccentric vision, particularly when the fixation area is divided. In vascular accidents, sparing of the fixation area is the rule, since only one of the two arteries supplying the occipital cortex is likely to be occluded. In traumatic lesions, sparing is frequently not observed, since both arteries may be damaged or the entire cortex may be destroyed.

It should be pointed out that the cortical representation of the macula is quite large as compared with the area representing the larger peripheral portions of the retina. The proportionate representation is analogous to the large motor and sensory areas in the parietal cortex which represent the finger and thumb, as compared with the smaller areas which represent the trunk and the extremities.

In the area striata, the periphery of the retina is represented near the anterior end of the calcarine fissure. Lesions in this area practically always involve the optic radiations also. Few authentic cases are on record in

which isolated injuries of this area occurred. One of the cases reported by Holmes and Lister, two cases reported by Scarlett and Ingham,[5] and perhaps cases eight and nine presented in this chapter (pp. 323–327), are instances of isolated injuries, but in none of these patients can damage to the optic radiations positively be excluded.

The upper portion of each retina is represented on the area superior to the calcarine fissure, while the lower portion of the retina is represented on the area inferior to this fissure. When, therefore, the area below the calcarine fissure is injured, a defect in the upper fields of vision should be observed and vice versa. Such defects are seldom seen, however, since wounds in this area are likely to be fatal because of damage to the cerebellum and large blood vessels.

According to Traquair,[6] although traumatic lesions of the optic nerve and occipital lobe are frequent, trauma to the chiasm is uncommon, and lesions in the geniculocalcarine pathway are more often vascular than traumatic in origin.

Riddoch [7] and Holmes [8] both presented interesting data regarding the dissociation of visual perceptions following injuries of the occipital lobe. The also pointed out that patients may see movement in the blind field and discussed the prognostic value of this phenomenon. They thought that such lesions probably were located in the region of the supramarginal and angular gyri in the parietal lobe. Some of the histories presented in this chapter suggest the possibility of such dissociations, although the cases were not studied from this angle.

CASE REPORTS

The 12 cases reported in this chapter were observed at Valley Forge General Hospital between October 1943 and February 1945. Similar cases were undoubtedly observed at other general hospitals. These cases illustrate a variety of defects in the visual field, which could be traced to injuries of known type and in known sites. Neurosurgical and roentgenologic observations furnish supporting evidence in every case.

Case 1.—A 21-year-old soldier was wounded by shell fragments 7 August 1944, sustaining a skull fracture in the left parieto-occipital region with multiple depressed fragments of bone, laceration of the dura and the brain, and an intracerebral clot. Two days later, craniotomy was performed, and the dura was repaired with fascia lata. Healing was uneventful, except that cerebrospinal fluid drained for about 4 weeks and a palpable depression remained at the site of injury.

Roentgenogram of the skull (*fig. 47A*) revealed an oval area of bony dehiscence, 5 by 3 cm. in the posterior portion of the left parietal bone and the anterior portion of the left

[5] Scarlett, H. W., and Ingham, S. D.: Visual Defects Caused by Occipital Lobe Lesions: Report of Thirteen Cases. Arch. Neurol. & Psychiat. 8: 225–246, September 1922.

[6] Traquair, H. M.: An Introduction to Clinical Perimetry, ed. 4. London: Henry Kimpton, 1942.

[7] Riddoch, G.: (1) Dissociations of Visual Perceptions Due to Occipital Injuries, Especial Reference to Appreciation of Movement. Brain 40: 15–57, 1917. (2) Visual Disorientation in Homonymous Half-fields. Brain 58: 376–382, 1935.

[8] Holmes, G. H.: Disturbance of Visual Orientation. Brit. J. Ophth. 2: 449–468, 506–516, 1918.

leaf of the occipital bone. Three metallic clips were visible in this defect, and a metallic shadow and an indefinite calcified mass 1.5 by 1 cm. were seen 4 cm. medial to the center of the defect.

The field defect (fig. 47B) was right homonymous hemianopsia congruous with sparing of the fixation area and of a small portion of the lower right field adjacent to the midline. Vision in both eyes was 20/15 (Jaegers #1).

The site of injury, the data obtained at operation, the roentgenologic findings, and the field defect, indicated a lesion of the left occipital cortex. Sparing of the fixation area was probably attributable to the dual blood supply of the area from the calcarine and the middle cerebral arteries. Another possibility, to be considered in all cases, was fortuitous escape from injury of that portion of the area striata representing the fixation area; that is, the posterior tip and the lateral surface of the occipital pole.

Case 2.—A 24-year-old soldier, wounded by fragments of an 88-mm. shell 15 June 1944, sustained a compound depressed fracture of the skull with injury to the brain in the right temporoparietal area. A metallic foreign body was retained in the left occipital lobe of the brain, and the patient suffered complete hemianesthesia with no loss of motor function.

The shell wound of the skull and brain was debrided on the day of injury, and bleeding from the temporal and middle meningeal arteries, the temporo-occipital veins, and the severed inferior petrosal sinus was arrested. Lacerated, contused dura and tissue from the temporal and occipital lobes of the brain were removed by suction. A fascia lata graft was used to close the defect in the dura. Large sections of bone had to be removed in order to elevate the depressed fracture and control bleeding. In spite of a transfusion of 3,000 cc.,



FIGURE 47.—Right homonymous hemianopsia following head injury. A. Roentgenogram of skull.

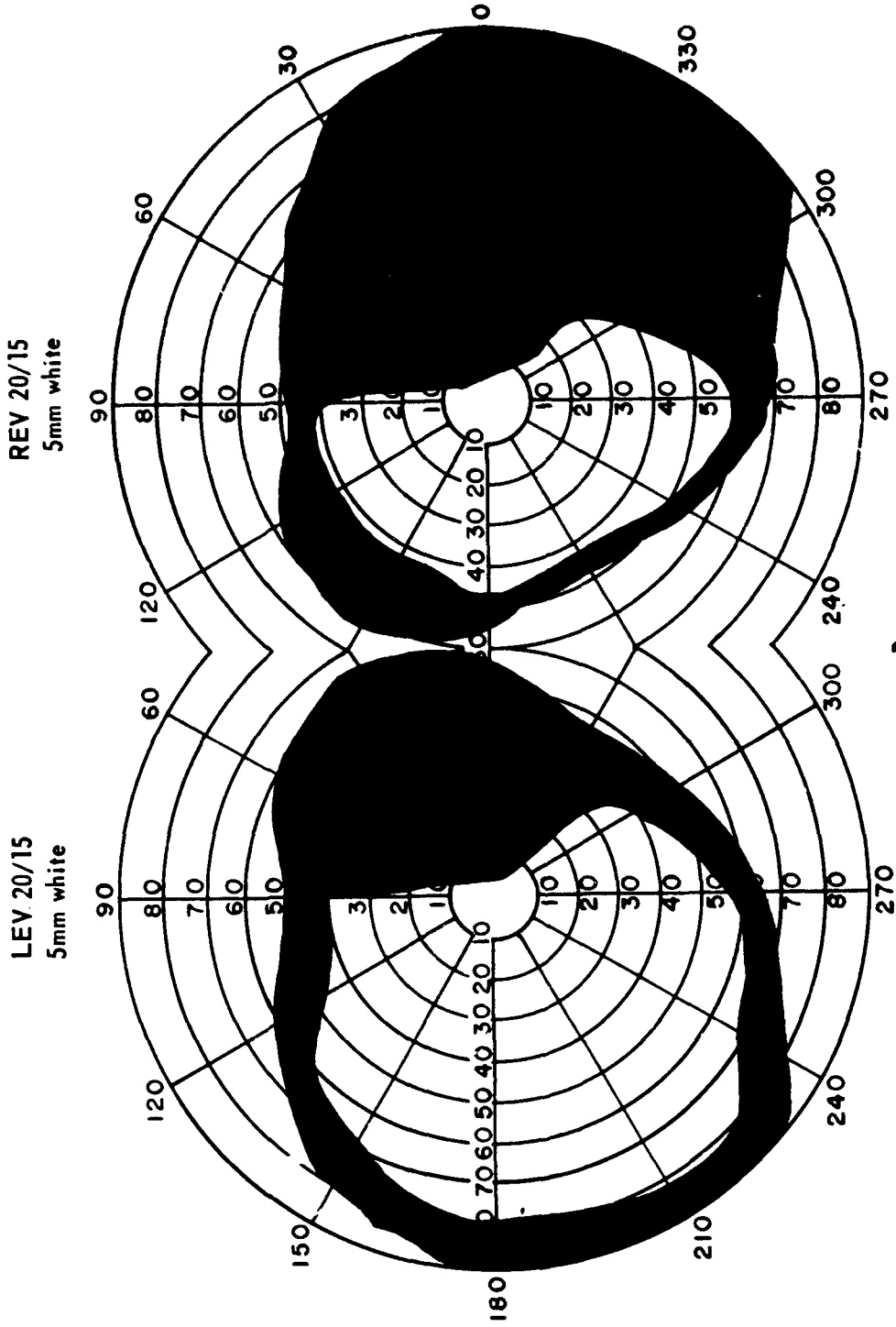


FIGURE 17. Continued. B. Visual fields taken with 5-mm. test object.

neither pulse nor blood pressure could be elicited for a period of 40 minutes. Five hours after operation, the blood pressure was 120/80 mm. Hg.

The patient remained unconscious from the time of injury until 14 days after operation. Then he was found to be totally blind. He could move his left arm and left leg, though he had no sense of position, and he had loss of sensation over the left side of the body. There was no speech defect, and no personality changes were noted.

Roentgenologic examination (fig. 48A) at this time showed an extensive comminuted fracture of the right temporoparietal area, with a large separated fragment in the upper occipital area. A metallic fragment measuring 5 by 4 cm. was present in the left occipital lobe. Repetition of the examination 28 August 1944 showed a very large bony defect involving the posterior half of the right parietal bone, the temporal bone, the upper margin of the mastoid, and a small portion of the adjacent occipital bone, with two radiating linear fractures through the occipital bone. A metallic foreign body measuring 2.3 by 1.3 by 0.7 cm. was present in the left occipital lobe; it lay 1.5 cm. to the left of the midline and 1.5 cm. deep to the inner table. Electroencephalogram showed an abnormal record indicative of damage to the right occipital and parietal areas.

On 7 September 1944, a tantalum plate measuring 11.5 by 11.5 by 14 cm. was inserted to cover the bony defect in the skull.

The field defect (fig. 48B and C) in this case was left homonymous hemianopsia, with division of the fixation area. There was no direct injury to either eye. Vision was as follows: Right eye, light perception; left eye, 2/200. Reduction in vision was thought to be caused in part by extensive vitreous hemorrhages, although there were no visible lesions in the fundi. The hemorrhages were explained by sudden increase in intracranial pressure, with consequent compression of the vaginal space of the optic nerves and bleeding from the central veins.



FIGURE 48.—Left homonymous hemianopsia following head injury. A. Roentgenogram of skull.

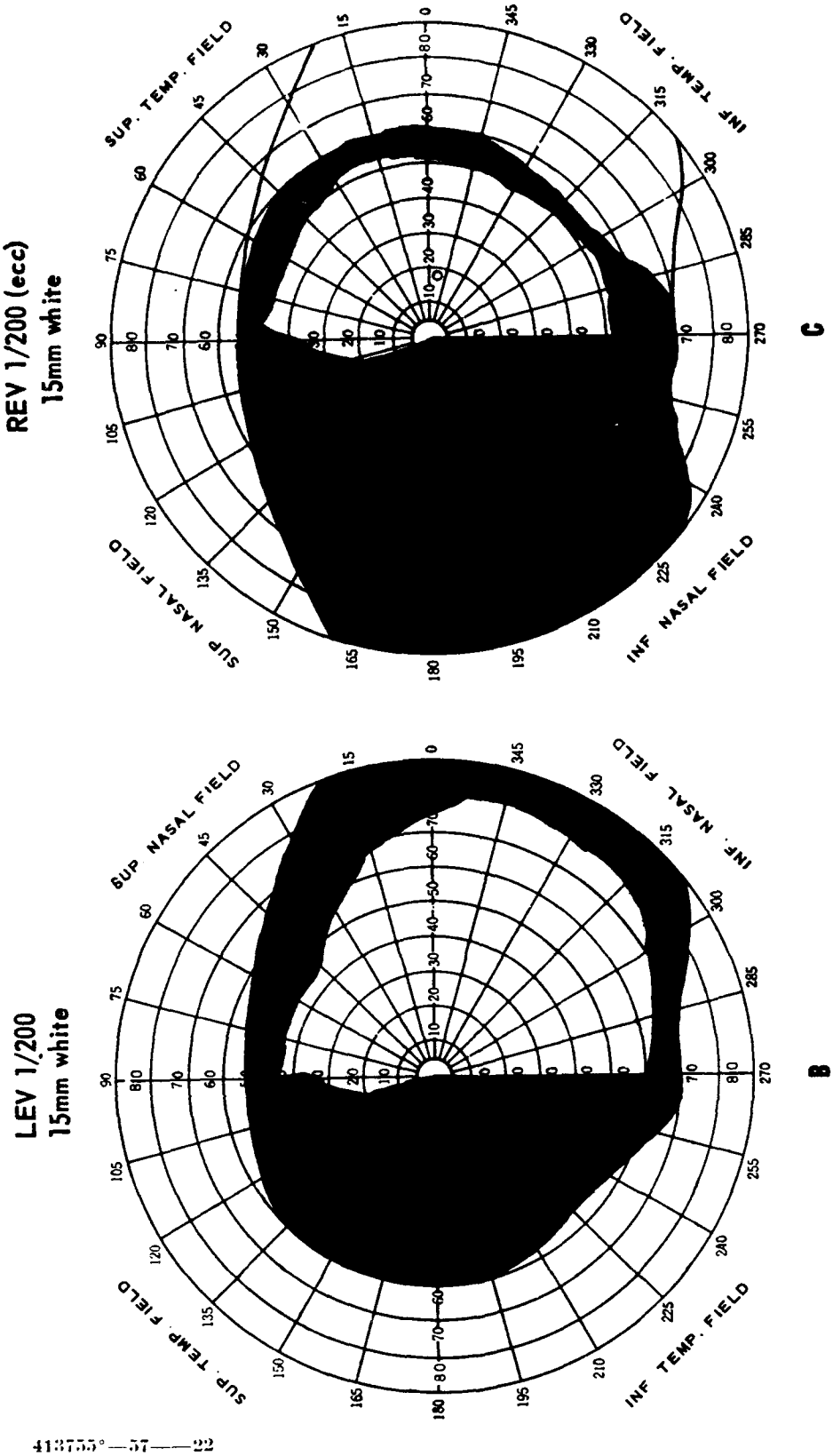


FIGURE 48.— Continued. B and C. Visual fields taken with 15-mm. test object at distance of 330 mm.

Injury to the right occipital and parietal lobes by penetration of a foreign body accounted for the left homonymous hemianopsia, left hemianesthesia, and mild left hemiplegia. The field defect, which was noted as early as 11 August, remained unchanged after the vitreous hemorrhage was largely absorbed. The foreign body in the left occipital lobe apparently did no damage to the visual fibers or the cortex.

Case 3. A 23-year-old soldier, wounded by shell fragments 26 September 1944, sustained a severe compound comminuted fracture of both leaves of the occipital bone, with

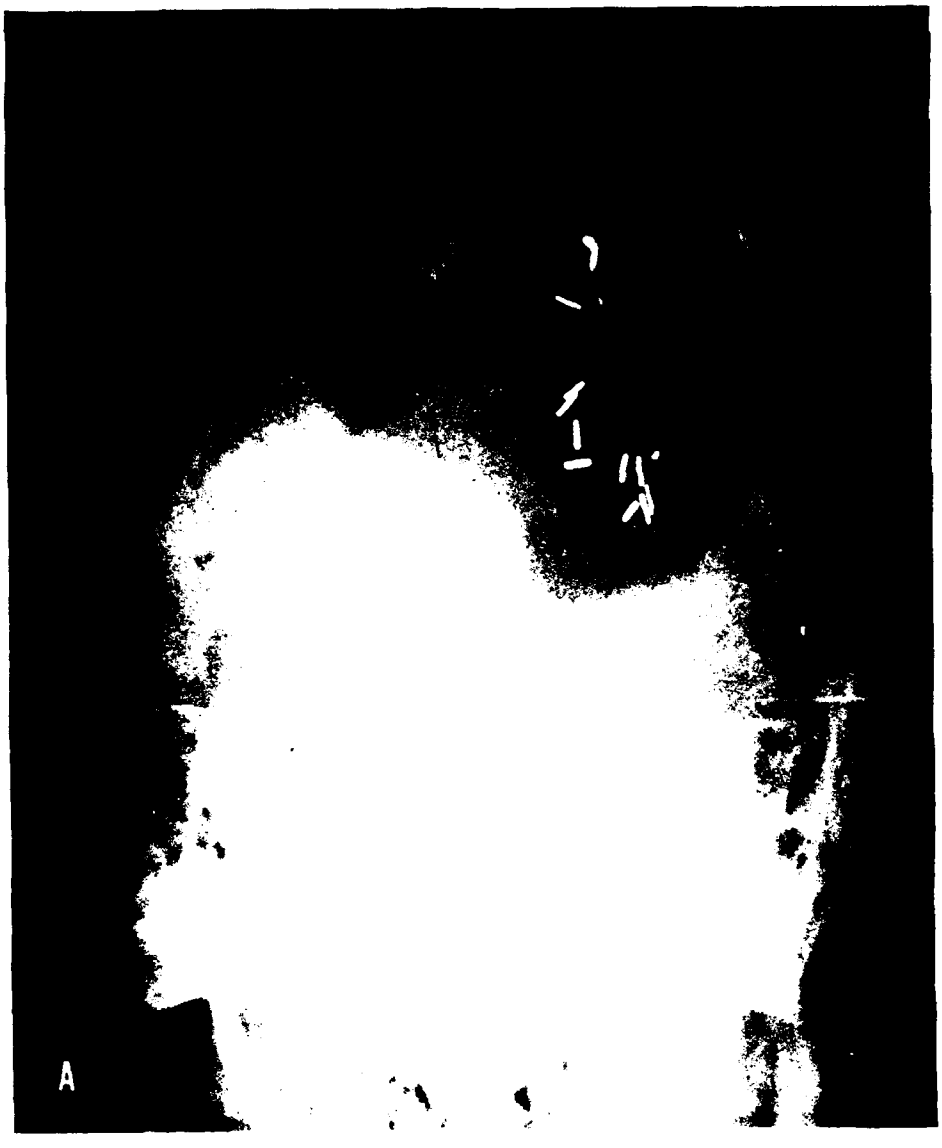


FIGURE 49. Right homonymous hemianopsia following head injury. A. Roentgenogram of skull.

extensive stellate fractures of both parietal bones. Multiple metallic foreign bodies entered the head to a depth of 5 to 6 cm. in the left parieto-occipital area.

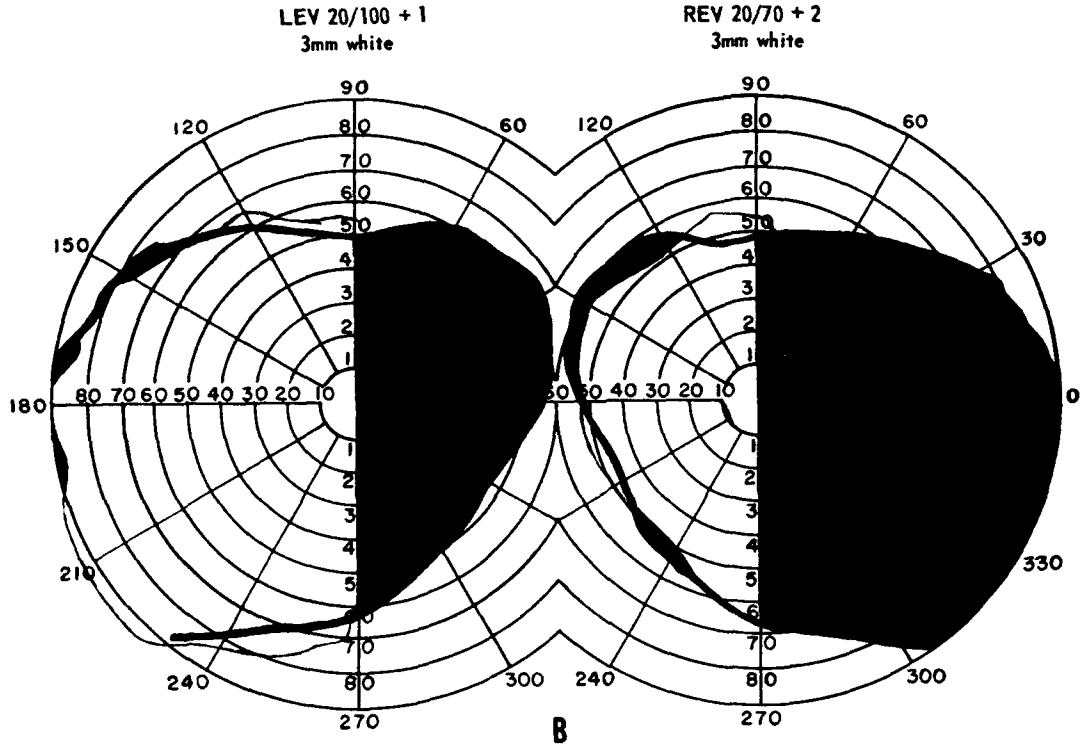
Craniotomy was performed the day after injury. When wide debridement and removal of bone fragments had been carried out, a defect measuring 6 by 3 cm. was left in the occipital bone. The dura was torn to the left of the midline, and a subdural hematoma was present. The hematoma and the damaged brain tissue were removed, and the track of the foreign body in the left occipital lobe was irrigated but the foreign bodies were not removed. The dural defect was closed with a pericranial graft, and the defect in the scalp was closed with a sliding flap.

Before operation, both pupils had reacted to light but examination now revealed no light perception in either eye. The soldier remained apparently blind for 15 days; then he was found to have light perception. He also exhibited sensory aphasia and generalized hyperreflexia.

Bilateral papilledema was present for a considerable length of time but eventually subsided, leaving yellowish nerve heads without physiologic cupping.

Roentgenologic examination of the skull (fig. 49A) showed a semilunar defect measuring 4 by 8 cm. in the occipital bone, the larger portion lying to the left of the midline. Linear fracture lines extended in all directions from this defect, and a Y-shaped fracture extended upward from the greater wing of the sphenoid bone on the right. Two large foreign bodies were present in the brain near the left parietal bone, 9 cm. above the mastoid process.

The field defect (fig. 49B) in this case was right homonymous hemianopsia with division of the fixation area. Vision was 20/70 + 2 (Jaegers #12) in the right eye; 20/100 + 1 (Jaegers #12) with correction in the left eye. Some degenerative changes present in each macular area, secondary to prolonged papilledema, accounted for the poor visual acuity.



B

FIGURE 49.— Continued. B. Visual fields taken with 3-mm. white test object.

The data obtained at operation and roentgenologic examination, the injury to the occipital region, the track of the foreign bodies through the occipital and parietal lobes, and the field defect indicated damage to the left occipital cortex and deeper tissues of the brain. The sensory aphasia and hyperreflexia indicated damage to the parietal lobes.

When this patient was examined in June 1945, vision was as follows: Right eye, 20/50 -1 (Jaegers #9); left eye, 20/50 -1 (Jaegers #9). No papilledema was evident, but the disks were still yellowish.

Case 4. A 29-year-old soldier, wounded by a high-explosive shell 11 July 1944, suffered a depressed, compound comminuted fracture in the left parieto-occipital region, with damage to the dura and brain. There was also a transient sixth nerve palsy. The pupils reacted to light, and the fundi were normal.

Craniotomy was performed the day after injury. Multiple depressed bone fragments, hair, dirt, and soft brain tissue were removed, and the dural defect was repaired with pericranium.

Roentgenologic examination (fig. 50A) showed a debrided defect, 3.5 by 5.5 cm., in the superior occipitoparietal region with radiating linear fracture lines extending into the right and left lower occipital areas, into the right upper parietal area, and along the lateral portion of the right parietal bone into the right temporal bone. Some partially detached bone frag-



FIGURE 50. Left homonymous hemianopsia following head injury. A. Roentgenogram of skull.

ments lay in the left lateral portion of the bony defect, but no intracranial foreign bodies were evident. The optic foramina showed no abnormality.

The field defect (fig. 50B) was left homonymous hemianopsia with considerable loss of the right lower quadrant of the field of each eye, particularly the left, and with involvement of both fixation areas. Visual acuity was 20/200 in the right eye, 6/200 (both Jaegers #0, eccentric) in the left.

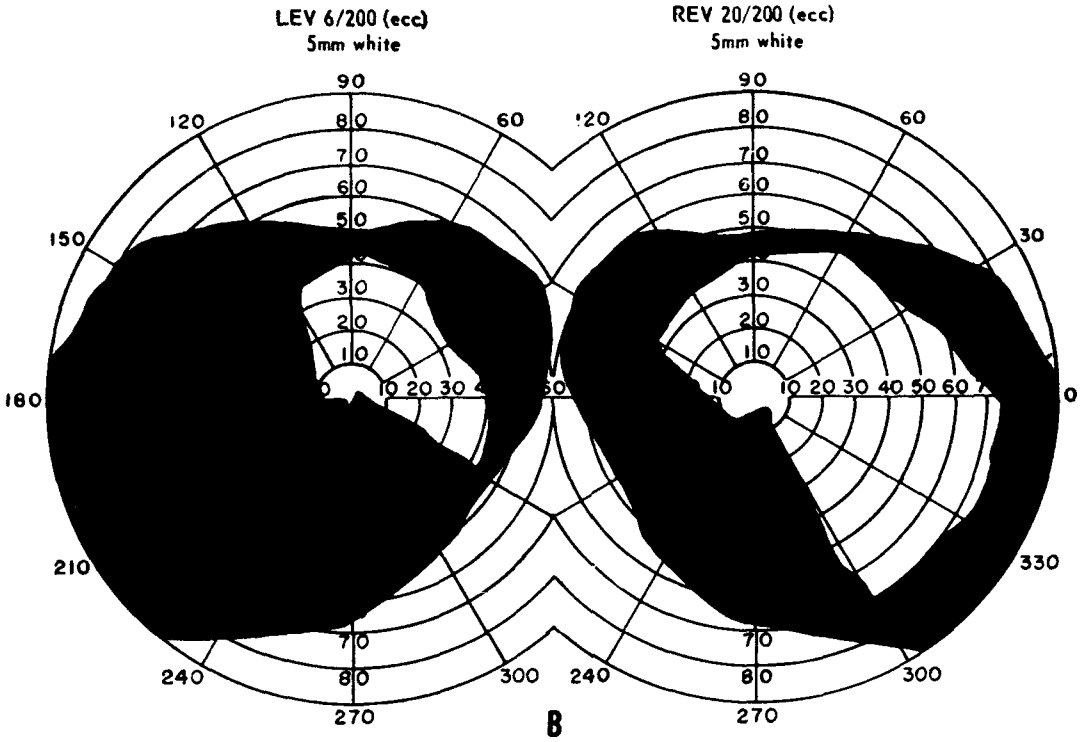


FIGURE 50. Continued. B. Visual fields taken with 5-mm. white test object.

The site of injury and the data obtained at the operation and by roentgenologic examination, together with the field defect, indicated damage to the posterior poles of both occipital lobes, especially the right, and to the optic radiations on the left. The fields varied somewhat between 18 December 1944 and 8 January 1945.

Case 5.—A 31-year-old soldier, wounded 8 August 1944 by fragments of mortar shell, sustained a compound comminuted fracture of the occipital bone, more extensive to the right of the midline, with damage to the right occipital lobe by depressed bone fragments.

Craniotomy was performed 2 days later. The tip of the right occipital lobe and the calcarine area were found reduced to pulp by deeply indriven fragments of bone. The dura was torn on both sides of the midline, and the longitudinal sinus was lacerated and thrombosed. Bone fragments and pulped brain tissue were removed.

The patient remained unconscious for 11 days and was completely blind for several additional days. Later, he was able to count fingers. Left homonymous hemianopsia was present on the confrontation test. The fundi were normal.

Roentgenologic examination (fig. 51A) showed an irregular defect measuring 4.5 by 6 cm. and involving the occipital bone on both sides of the midline. A stellate fracture extended through the right parietal bone and terminated in the right frontal bone.

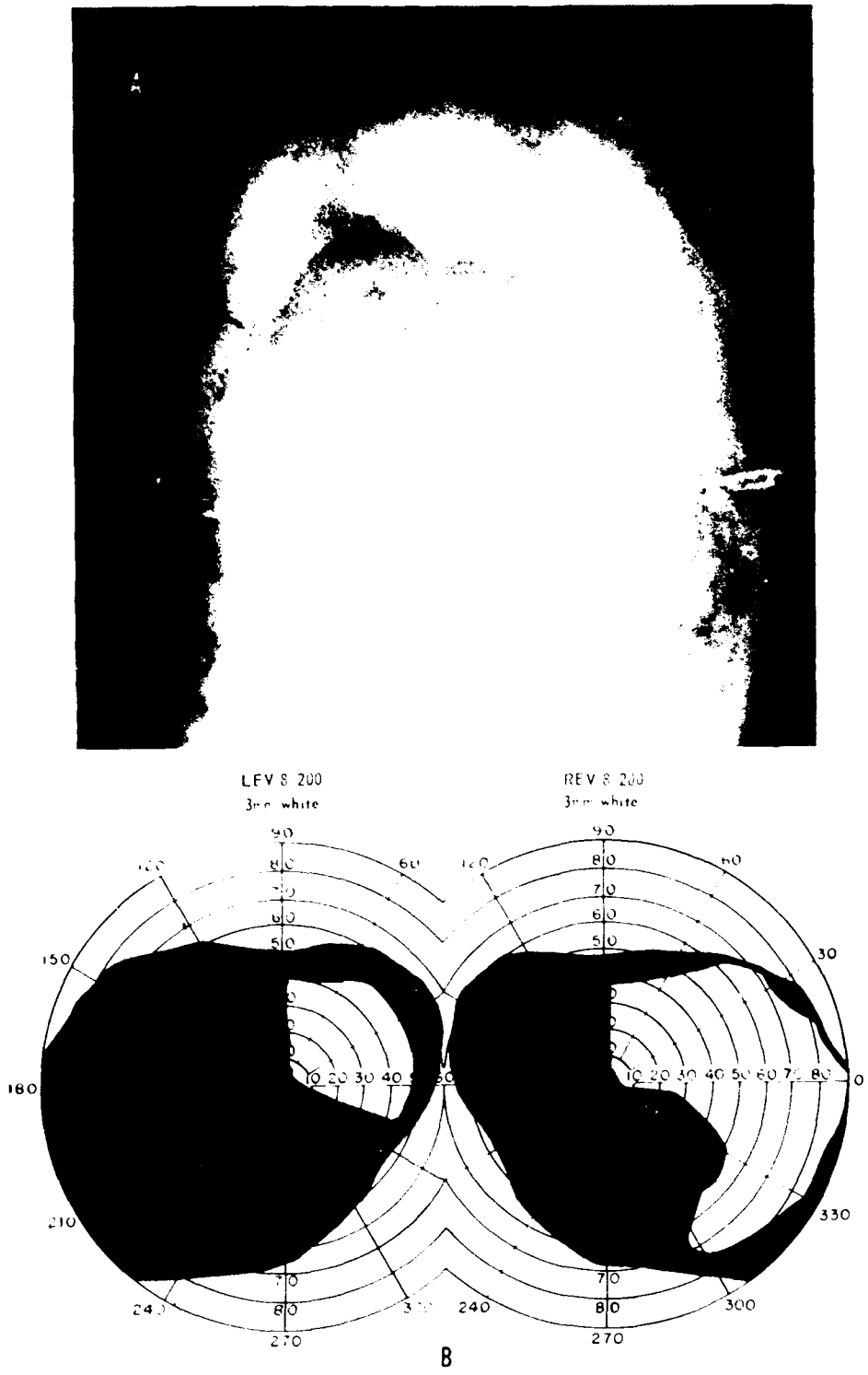


FIGURE 51. Left homonymous hemianopsia following head injury. A. Roentgenogram of skull. B. Visual fields taken with 3-mm. white test object.

The field defect (fig. 51B) in this case was left homonymous hemianopsia with involvement of both fixation areas and loss of a large portion of the right lower quadrant of the field. Vision in the right eye was finger count at 3 feet (Jaegers #0); left eye, finger count at 4 feet (Jaegers #0).

The left homonymous hemianopsia was assumed to be caused by damage to the right calcarine area. It was postulated that, to produce a lower field defect with loss of fixation area, the damaged area in the left occipital cortex must lie above the calcarine fissure and involve the tip of the posterior pole.

Case 6.—A 19-year-old soldier was wounded by a sniper's bullet 18 May 1943. He sustained a wound of the gutter type, 2.5 by 7.5 cm., in the posterior portion of the parietal bones and the superior portion of the occipital bone, chiefly to the left of the midline. Fragments of bone were indriven, and brain tissue was herniated through an infected wound, from which cerebrospinal fluid was draining. Because of the infection, it was not possible to close the scalp wound until 15 June; then, pinch grafts were used.

The pupillary reaction to light was normal. The fundi were normal.

Roentgenologic examination (fig. 52A) revealed a gross defect involving the posterior aspect of both parietal bones and the superior portion of the occipital bone. Metallic foreign bodies and fragments of dead bone were seen in the brain substance. The fracture lay chiefly to the left of the midline; a linear fracture extended into the left parietal bone.

The field defect (fig. 52B and C) was complete right homonymous hemianopsia, with loss of about half of the lower left field of each eye and involvement of both fixation areas.

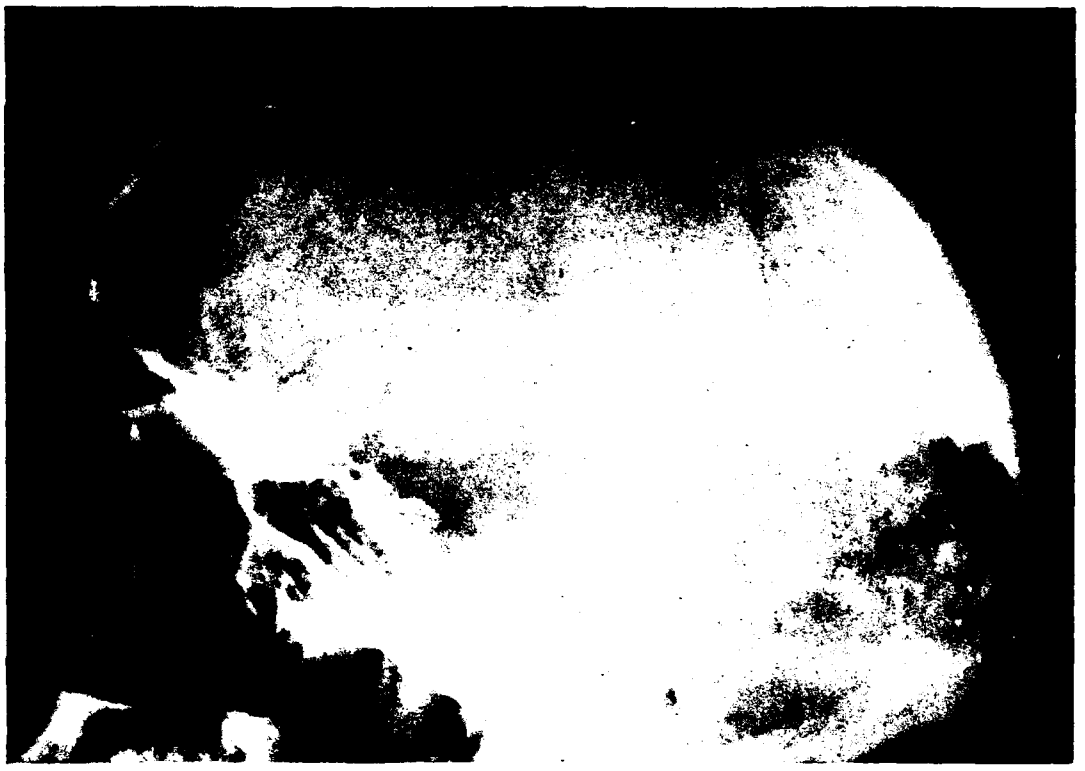
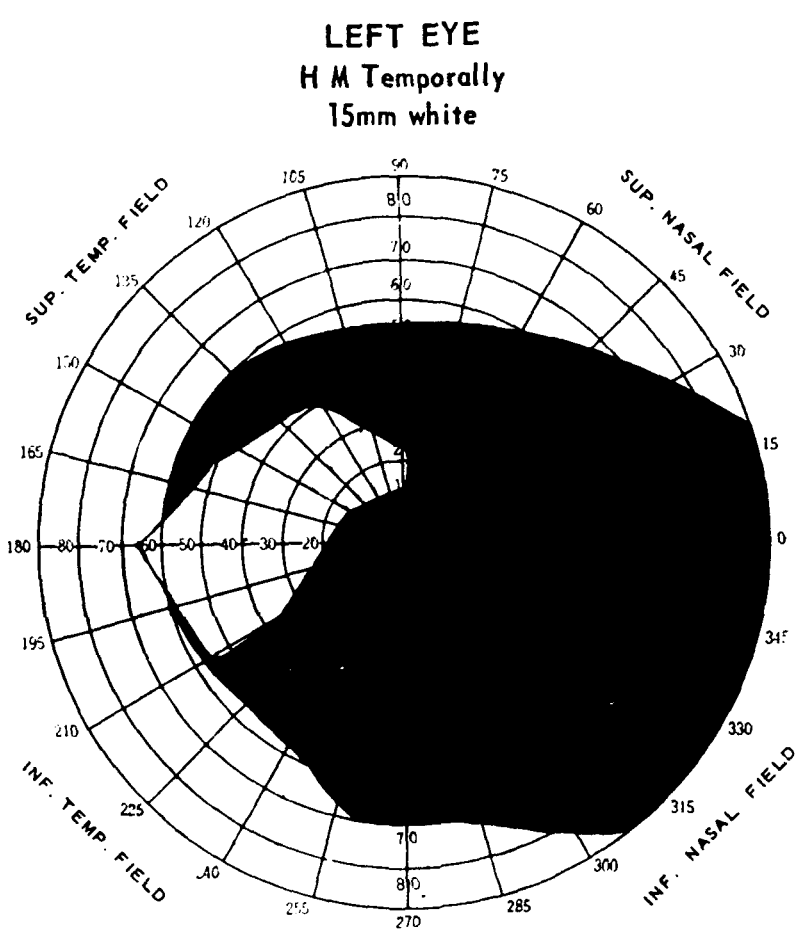


FIGURE 52.—Complete right homonymous hemianopsia and loss of temporal periphery of temporal field in left eye following head injury. A. Roentgenogram of skull.



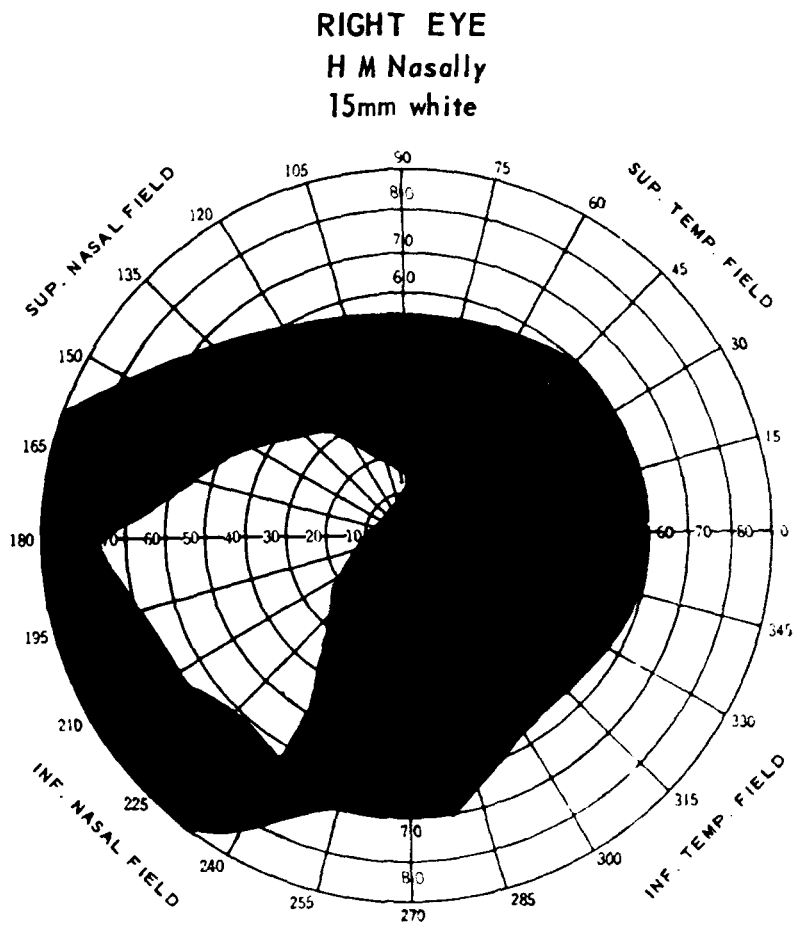


FIGURE 52 Continued. B and C. Visual fields taken with 15-mm. test object.

There was also loss of the temporal periphery of the temporal field in the left eye. Vision in the right eye was limited to hand movements nasally and on the left side to hand movements temporally.

The location of the defect in the skull combined with the field defect indicated damage to the left occipital cortex, with lesser damage to the right cortex at the posterior pole and above the level of the calcarine fissure. These injuries produced the defect in the left lower fields and involvement of the fixation areas.

Case 7.—A 26-year-old soldier, wounded 29 April 1944 by shell fragments, sustained a compound comminuted fracture of the right parietal region, with herniation of brain substance from the wound. The patient was totally irrational and had a complete flaccid left hemiplegia.

Craniotomy was performed the followjng day. Devitalized brain tissue was debrided, and the wounds were closed primarily. Reherniation of brain tissue necessitated a second craniotomy 7 days later, and a third was performed still later because of a deep-seated abscess in the posteroparietal area. The patient showed marked improvement following the third operation and for the first time became rational and cooperative, though he exhibited marked variations in mood. He was said to be totally blind. Massive intraocular hemorrhages had been noted, though there was no evidence of direct trauma to the eyes.

Roentgenologic examination (fig. 53A) showed an area of bony dehiscence in the midportion of the right parietal bone, adjacent to the sagittal suture and measuring 6 cm. in

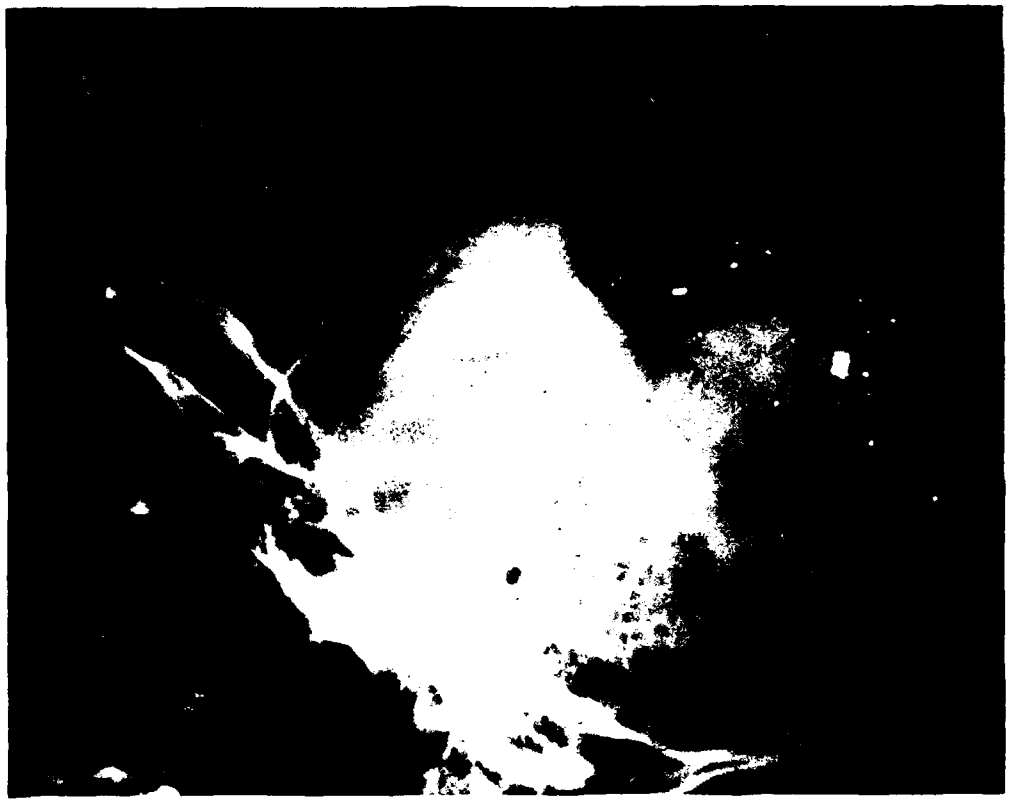
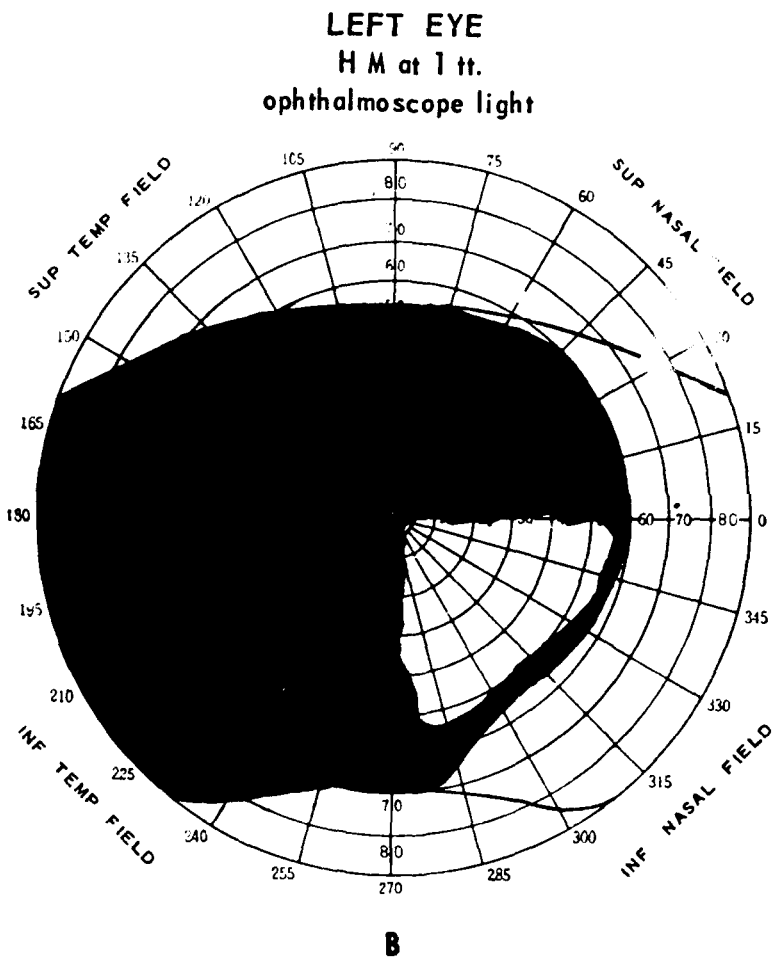


FIGURE 53.—Almost complete loss of right lower fields of vision following head injury. A. Roentgenogram of skull.



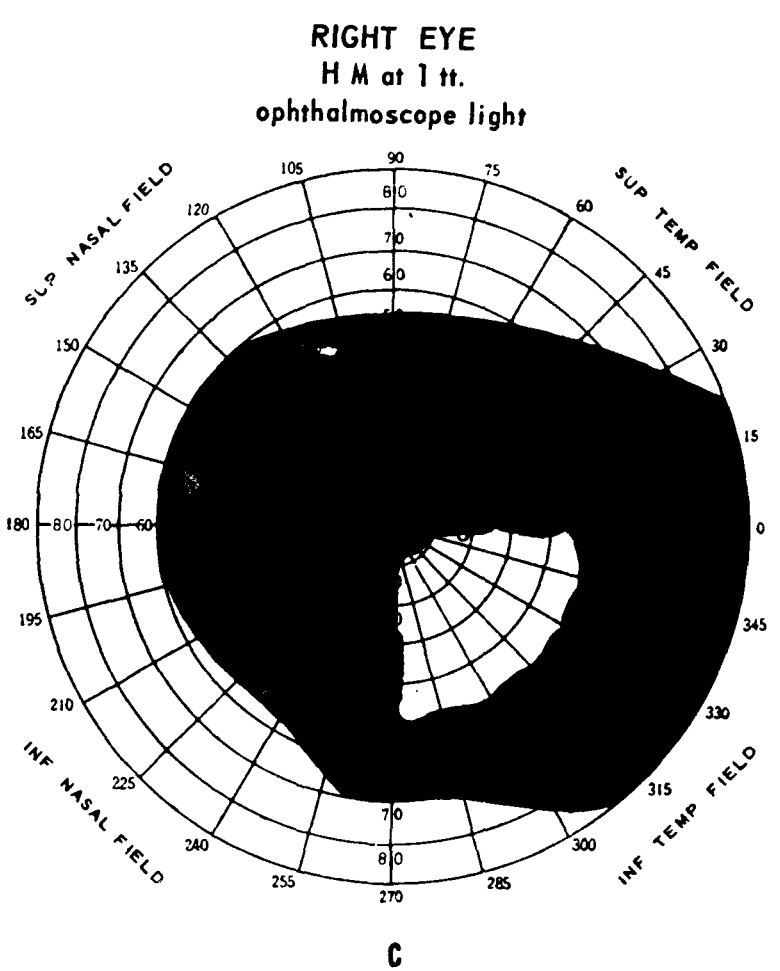


FIGURE 53. Continued. B and C. Visual fields taken with ophthalmoscopic bulb test object.

diameter. Two linear depressed fractures extended downward and upward, respectively, from this defect into the base of the skull.

The field defect (fig. 53B and C) in this case was loss of all but a portion of the right lower fields of vision, with loss of both fixation areas. Vision on both sides was limited to hand movements at 1 foot.

Examination of the occipital lobes was not carried out at operation, but it was assumed that bilateral damage to these lobes, greater on the right side, with damage above the level of the calcarine fissure, would explain the field defect. A diagnosis of penetrating wound of the right frontoparietal region had been made overseas, with the track of numerous small metallic foreign bodies traversing the brain from this area through the right parietal lobe into the left occipital lobe. On this basis, only widespread damage to the right optic radiations, including the macular fibers, and damage to the left occipital lobe could explain the defect, but the evidence in the record was insufficient to permit the statement of this possibility as a fact. Another possibility to be considered in this case is a contrecoup injury to both occipital lobes. The vitreous hemorrhages, without evidence of direct injury to the eyes, might be explained by sudden increase in intracranial pressure, with consequent pressure on the vaginal sheaths of both optic nerves and hemorrhage from the central vein.

Case 8. A 34-year-old soldier, wounded 25 March 1944 by fragments of artillery shell, sustained an H-shaped compound comminuted depressed skull fracture in the midoccipital region, just above the lambdoidal suture. Four deeply placed metallic foreign bodies were near the midline, and another was in the right occipital lobe.

Craniotomy was performed the day of injury. It revealed a 2-cm. laceration of the dura over the right occipital lobe, with a track extending 6 cm. anterolaterally into the occipital lobe. The track was debrided, and a foreign body lying at the end was removed with a magnet. Removal of a 3-cm. depressed bone fragment revealed a laceration of the superior longitudinal sinus.

The patient complained of complete blindness but at first was conscious, rational, and oriented. Pupillary reactions and extraocular muscular movements were normal. On 28 May, stertorous breathing developed, and there was loss of all muscle tone. Lumbar puncture revealed freshly bloody fluid under increased pressure. Gradual improvement ensued. Ventriculography was performed 12 April, bilateral trephines being done in the posterior parietal regions. The lateral ventricles were dilated, and there was asymmetry of the occipital horns; the left failed to fill with air.

On 17 April, a second craniotomy was done. Debridement of necrotic tissue resulted in a cavity 5 by 3 cm. When the right ventricle was punctured, the brain began to pulsate for the first time. A second missile track, 1.5 cm. wide and about 8 cm. deep, was found running parallel to the right occipital horn. It was thought that a hemorrhage had occurred into the ventricle and that this accounted for the third nerve damage at the aqueduct.

Roentgenologic examination (fig. 54A) showed a large irregular defect in the midline of the skull involving the superior portion of the occipital bone and the posterior portion of the parietal bone. A small metallic foreign body lay 2 cm. to the right of the midline, deep to the superior border of the defect. The optic foramina showed no evidence of fracture.

The field defect (fig. 54B and C) was loss of all fields of both eyes except for retention of 2° in each fixation area. The patient had no vision for a long time after injury. By 18 June, vision in the right eye was light perception (Jaegers #0) and in the left, light per-

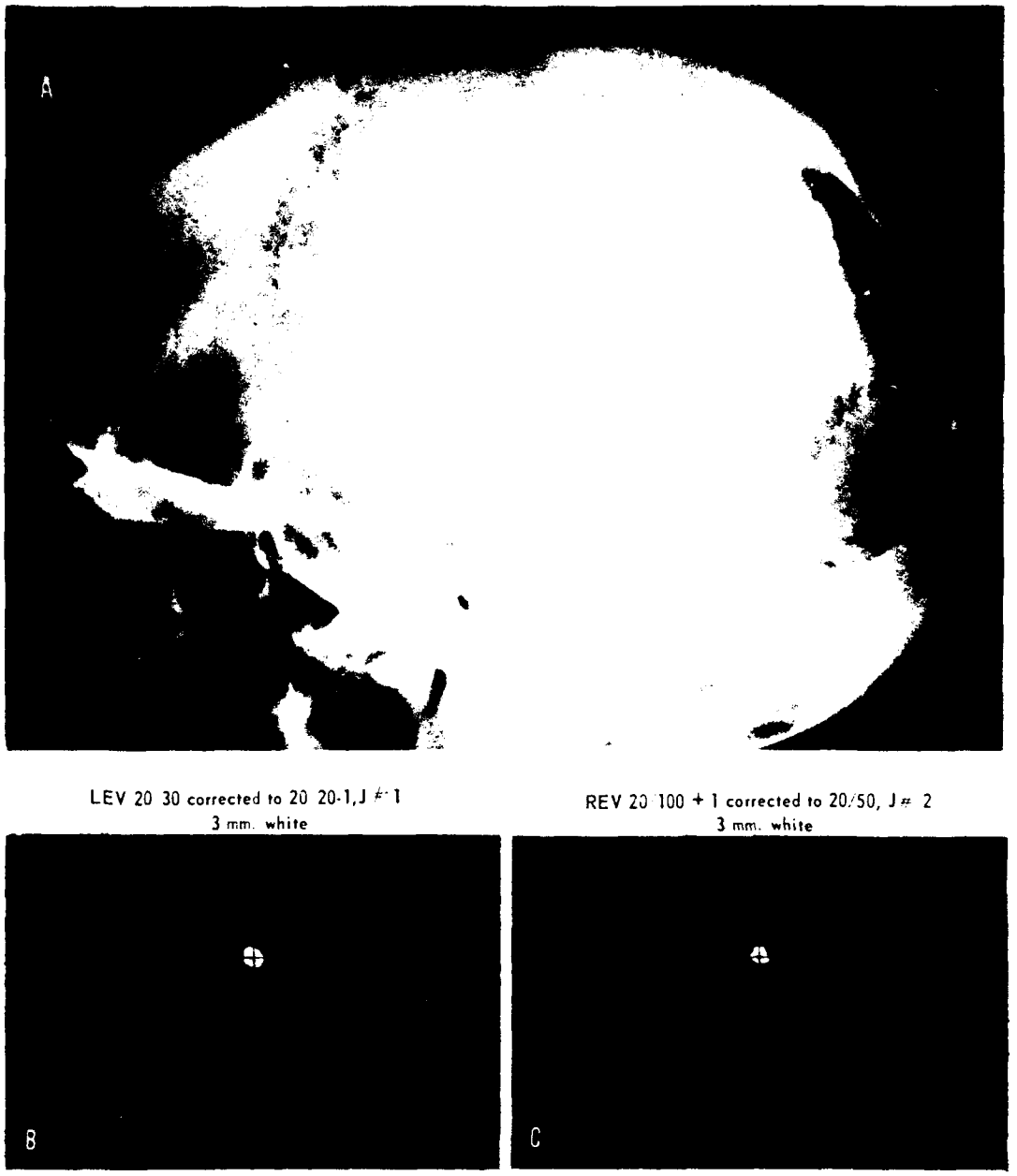


FIGURE 54. Almost complete loss of all fields of both eyes following head injury. A. Roentgenogram of skull. B and C. Tangent screen charts taken with 3-mm. white test object at distance of 1.5 meters.

ception (Jaegers #3), unimproved. By 18 January 1945, vision had improved in the right eye to 20/50 (Jaegers #2), and in the left to 20/20 − 1 (Jaegers #1), with correction.

Bilateral homonymous hemianopsia, with sparing of both fixation areas, indicated in this case a lesion of both occipital lobes without destruction of the tip of either lobe in the area in which macular vision is represented in the

cortex. This case is in direct contrast to case 11, in which bilateral central scotomas with normal peripheral fields were found. The exact extent of damage to the optic radiations could not be estimated. Improvement in vision could be accounted for by subsidence of edema in the occipital areas.

Case 9. A 26-year-old soldier, wounded 4 March 1944 by fragments of artillery shell, sustained a compound depressed fracture of the left leaf of the occipital bone. Several foreign bodies were in the left frontal lobe.

Craniotomy was carried out on the day of injury. The wound in the left occipital lobe was debrided, the longitudinal sinus was packed with muscle tissue, and closure was effected with a drain in situ.

On 11 March, although both pupils reacted to light, the patient was found to be completely blind. Bilateral papilledema was present. The following day, a second craniotomy was done, and a subdural hematoma, which was compressing the left hemisphere for a depth of about 1.5 cm., was evacuated. Necrotic tissue was removed from the left occipital lobe, which was badly damaged. A defect 3 cm. deep was left. A clot was then removed from over the right occipital bone, the cortex of which was completely liquefied. The neurosurgeon's notes at operation stated that the patient's blindness was accounted for by considerable damage to both occipital lobes. The damage did not appear, however, to have destroyed the calcarine area completely, and it was thought that after edema had subsided some vision might return, particularly in the upper fields.

By 23 March, the patient had light perception, and when he was first seen in the Zone of Interior he could tell time on a wall clock 10 feet away. By 16 November, his vision was 20/40 +1 (Jaegers #6) on the right, and 20/20 (Jaegers #1), on the left.

Roentgenologic examination (fig. 55A) showed a bony defect in the left postparietal area. This defect measured 6 cm. in diameter, and radiating fracture lines extended anteriorly. A later roentgenogram showed the defect after it was covered by a metallic plate

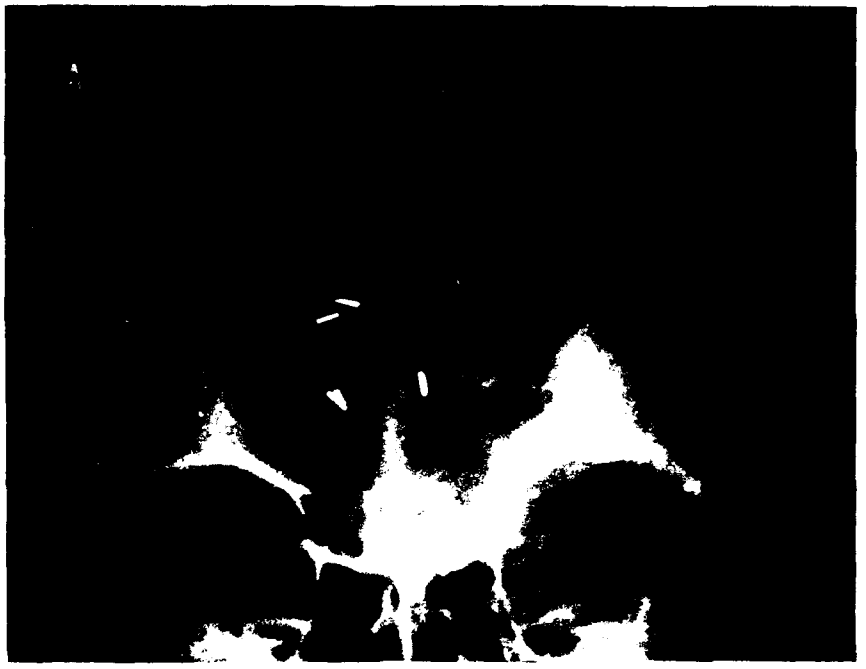


FIGURE 55.—Almost complete loss of all fields in both eyes, following head injury.
A. Roentgenogram of skull.

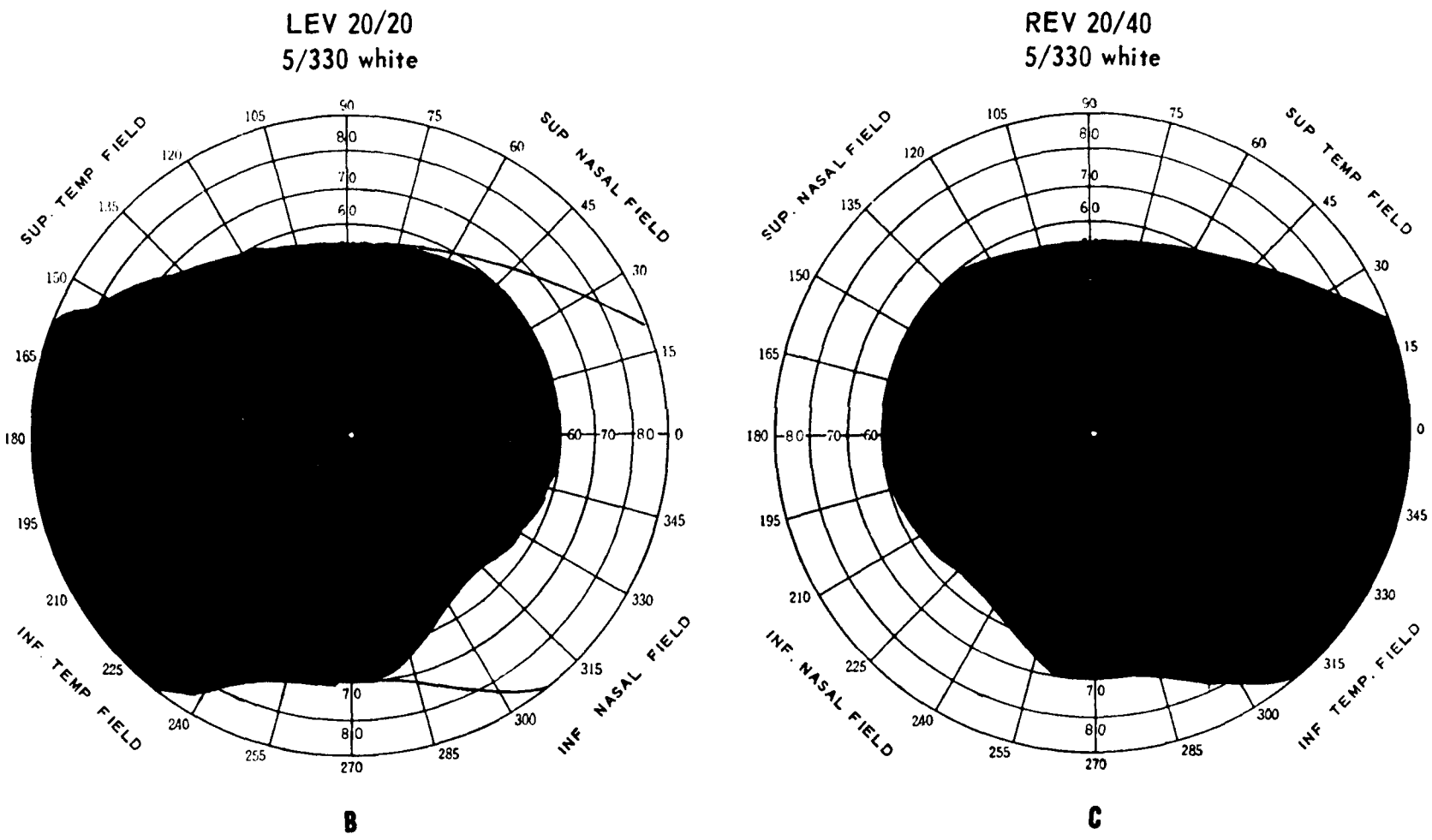


FIGURE 55. Continued. B and C. Visual fields taken with 5-mm. test object at distance of 330 mm.

The field defect (fig. 55B and C) was loss of all fields in each eye, except for retention of 1° in the fixation area. The patient could see quite clearly both near and at a distance but could read only a single letter at a time.

In this case, there was damage to both occipital lobes with, fortunately, sparing of the cortical areas representing the fixation area of the retina. Damage to the anterior portion of the calcarine area accounted for loss of the peripheral field. The fixation area of the cortex on each side must have been preserved; it was the neurosurgeon's impression that the entire cortex had not been destroyed. The radiations were undoubtedly damaged, this, as Holmes pointed out, being usual.

Case 10.—A 23-year-old soldier, injured in a plane crash 15 July 1943, suffered a compound depressed fracture of the skull in the midoccipital region, with contusion of the right occipital lobe.

Craniotomy to elevate the depressed skull fracture was performed 36 hours after injury. The skin edges were debrided down to the periosteum, and two bone fragments were pried up and removed; they lay just to the right of the torcular Herophili, measured 3 by 1 cm., and were driven inward 1.5 cm., so that they pierced the longitudinal sinus. Bleeding was arrested. The right portion of the occipital bone, which had been bent inward, was pried outward. The dura, which was intact and pulsating freely, was not

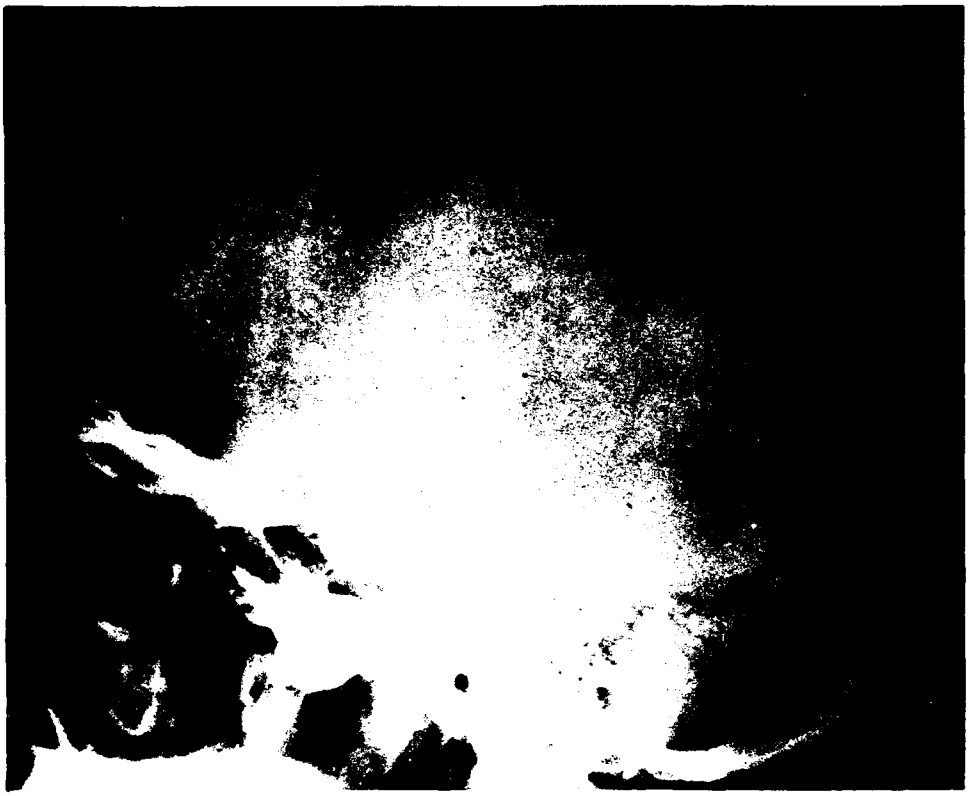
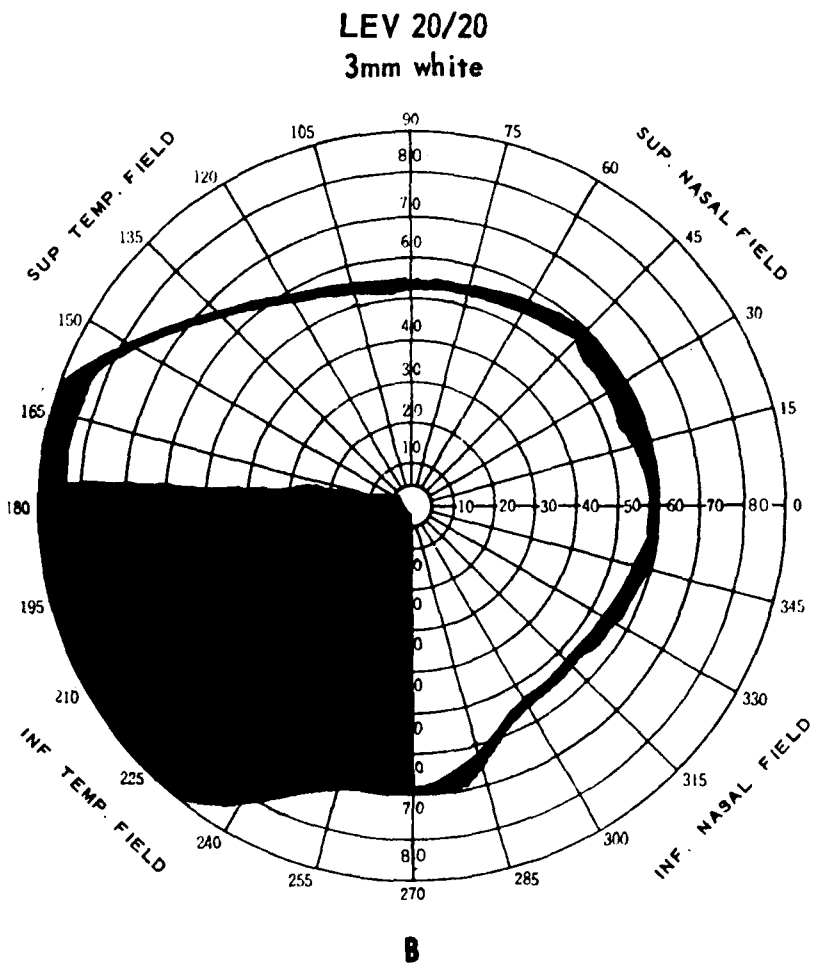


FIGURE 56.—Left homonymous hemianopsia following head injury. A. Roentgenogram of skull.



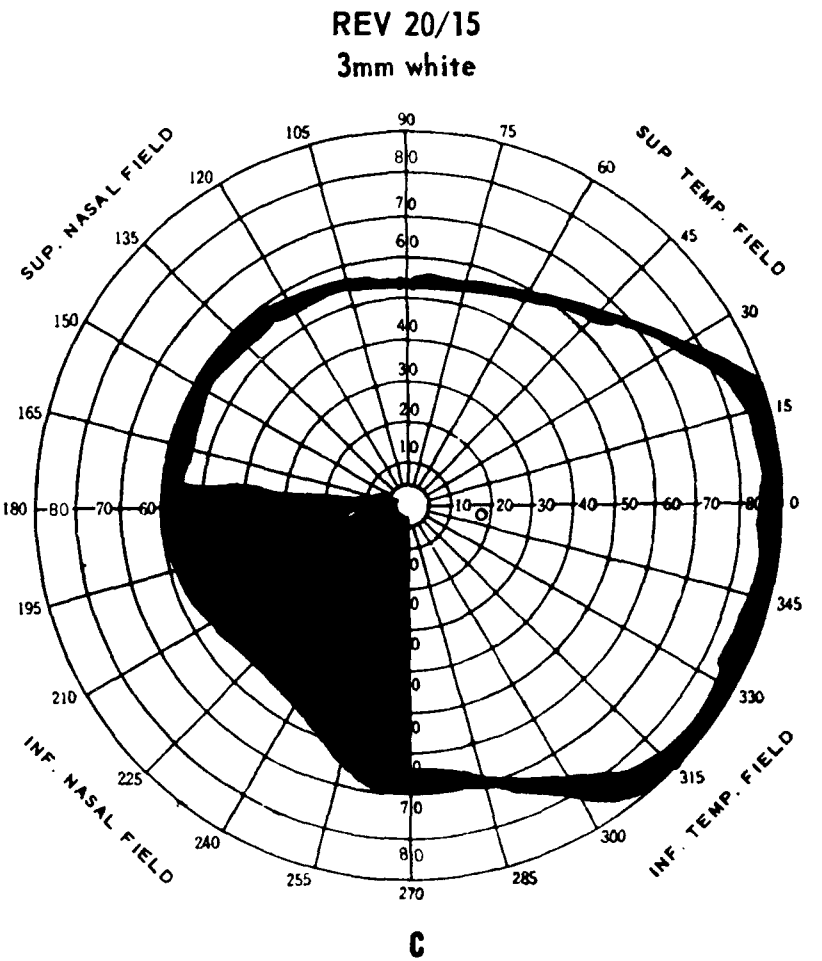


FIGURE 56. Continued. B and C. Visual fields taken with 3-mm. test object.

opened. The scalp was closed with a single layer of interrupted steel sutures. On 10 January 1944, an occipital skull defect about 5 by 4.9 cm. was repaired with a tantalum plate.

Roentgenogram of the skull (fig. 56A) revealed a large, irregular defect in the posterior aspect, beginning approximately 4 cm. above the lambdoidal suture and extending into the occipital bone approximately 4 cm. The defect involved chiefly the right side.

The field defect (fig. 56B and C), 13 August 1943, consisted of left homonymous hemianopsia with sparing of the fixation area. On 13 December, the defect was a left homonymous lower quadrant anopsia, with sparing of the fixation area. Vision in August was 20/30 (Jaegers #1) in both eyes. In December, it was 20/15 (Jaegers #1) in the right eye, and 20/20 (Jaegers #1) in the left.

The left homonymous hemianopsia in this case could be explained by damage to the right occipital cortex. The improvement in the field on the second examination, 4 months later, could be explained by subsidence of edema in the area adjacent to the destroyed cortex.

Case 11.— A 22-year-old soldier, wounded by shell fragments 27 March 1943, sustained injury to the occipital region. He became blind immediately after the injury and unconscious about 20 minutes later.

Debridement was performed the day after injury. Three days later, vision began to return and gradually improved until some time in May, when it became stationary. On 2 August, the depressed skull fracture was elevated, and numerous bone and shell fragments were removed from the brain tissue in the right occipital pole. The dura was opened on both sides of the longitudinal sinus. One bony fragment which had entered the longitudinal sinus was left in situ, since the attempt to remove it was associated with severe bleeding. Both occipital lobes were found grossly contused and degenerated and were represented by amorphous xanthomatous scarred cortex. The scarred cortex was freed as well as possible from the dura but appeared to be far beyond any hope of return of function. On 24 September, a tantalum plate was placed in the skull defect in the occipital region.

Roentgenogram of the skull (fig. 57A) showed a large defect in the midline of the occipital bone, the lower border being just above the union. The defect was covered with a metallic plate.

The primary field defect (fig. 57B and C) was a large absolute, right homonymous hemianoptic scotoma. Vision was 20/200, eccentric, in each eye.

The findings indicated damage only to the posterior tip of the cortex of each occipital lobe, more extensive on the left.

Case 12.—A 25-year-old soldier, wounded by an artillery-shell fragment 6 March 1944, received a blunt, nonpenetrating wound in the left frontal region. Forty-eight hours later, it was noted that the right pupil was smaller than the left. Both reacted sluggishly to light. Vision was poor in the right eye, and bitemporal hemianopsia was demonstrated. Neurologic examination was negative, except for paresis of the sixth nerve on the right. Operation was not performed.

Roentgenologic examination (fig. 58A) showed a fracture of the left frontal bone, beginning at the superior marginal rim of the orbit and extending upward and outward toward the midline. The anterior table of the left frontal sinus and the floor of the anterior fossa were involved in the fracture.

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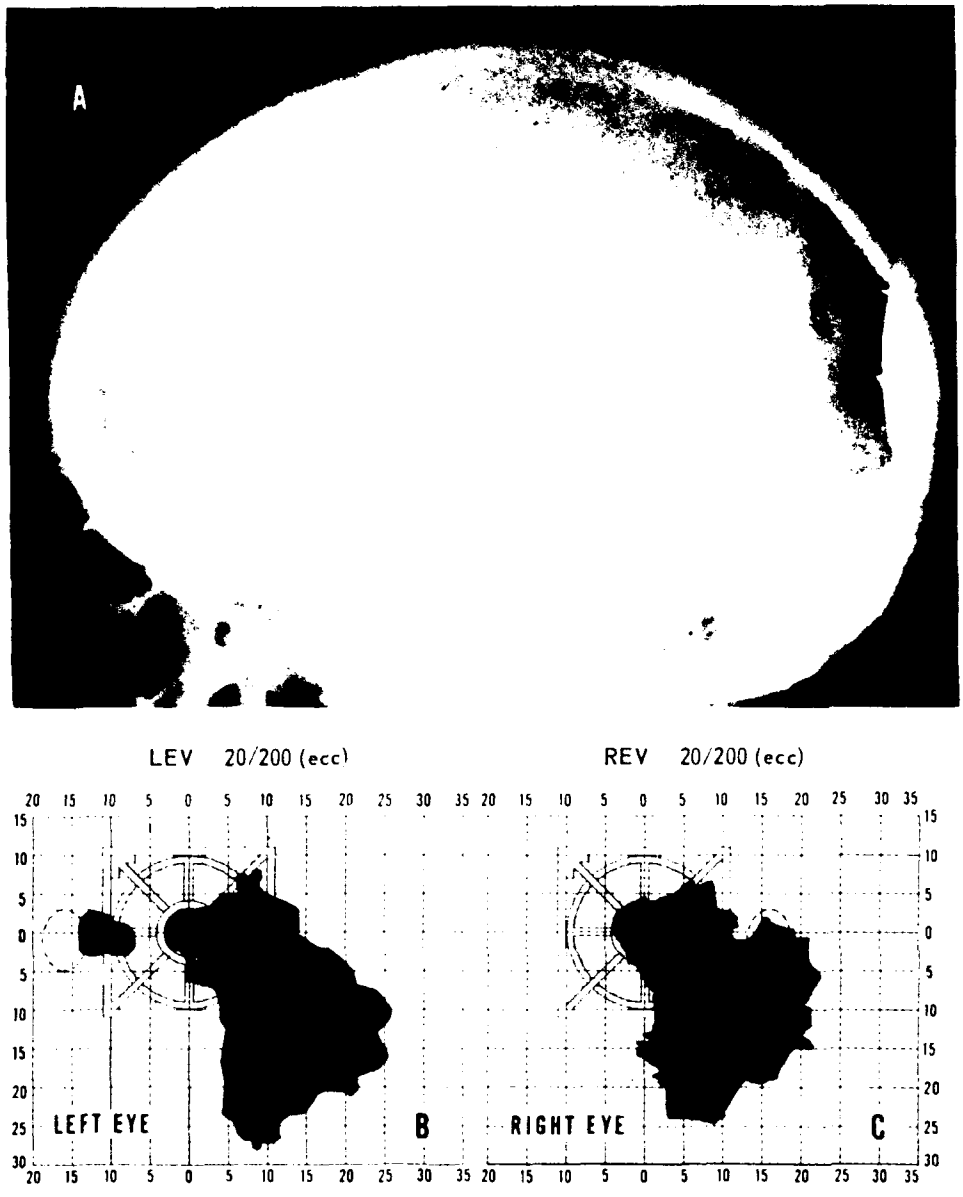


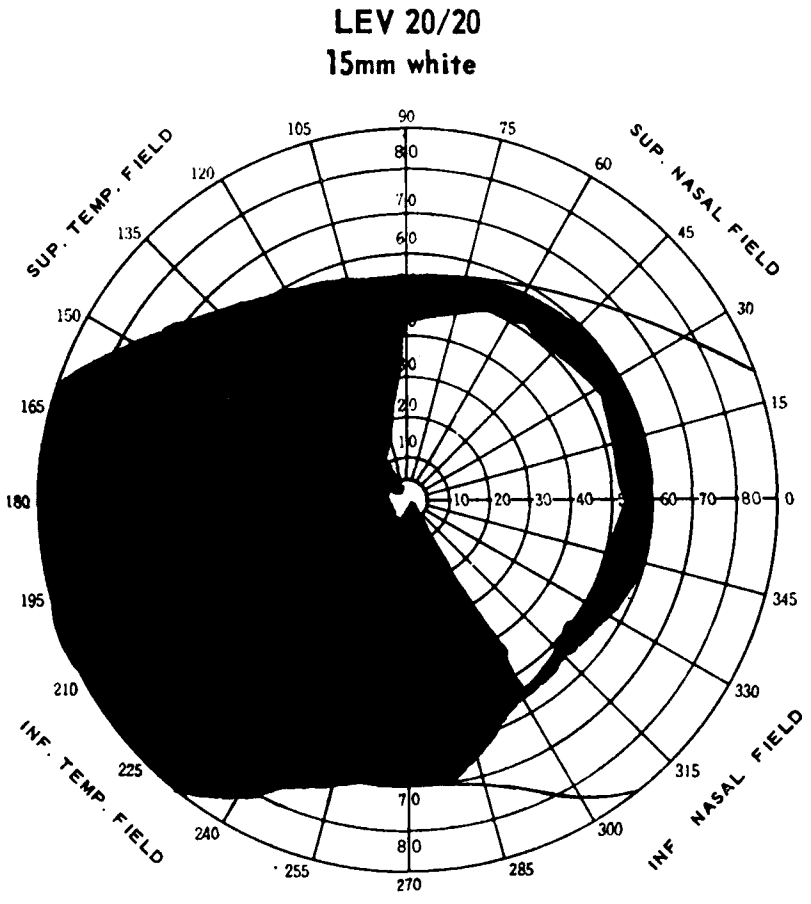
FIGURE 57. Large absolute homonymous hemianoptic scotoma. A, Roentgenogram of skull. B and C, Campimetric charts.

On 8 May 1944, the field defect (fig. 58B and C) was clear-cut bitemproal hemianopsia. On 10 October, there was loss of the entire temporal field in the right eye, with loss of the fixation area and of the outer 15° of the nasal periphery (fig. 58C). The fixation area was involved. On the left (fig. 58B), there was loss of the entire temporal field, except for a small area bordering the midline above the fixation area, which was not involved on this side. Vision on the right side was 1/200 eccentric (Jaegers #0) and on the left, 20/20 (Jaegers #1). The nerve head on the right was quite pale, and the lamina cribrosa was clearly seen. The left nerve head showed only a suggestion of pallor. The retinal arterioles were moderately attenuated.

It was assumed that in this case the lesion must lie in the chiasm and involve principally the midportion, with damage to the crossed fibers and sparing of most of the uncrossed fibers. The findings were in favor of this assumption. The first field examination showed clear-cut bitemporal hemianopsia, but later it was found that there was a defect in the peripheral portion of the right nasal field. Vision in the right eye was affected almost immediately after the injury.



FIGURE 58.—Bitemporal hemianopsia following head injury. A. Roentgenogram of skull.



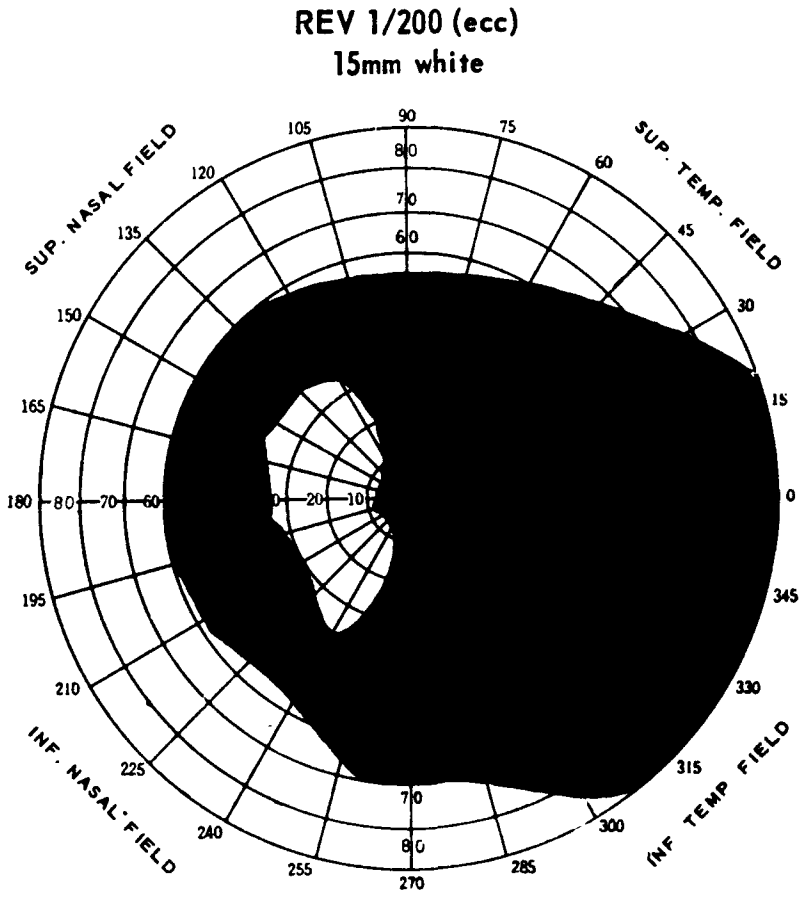


FIGURE 58.—Continued. B and C. Visual fields taken with 15-mm. test object.

COMMENT

Reports of cases of visual defects associated with head injuries are not numerous. In 1935, in a search of the literature, Traquair, Dott, and Russell [9] were able to find only 27 cases, to which they added 3 of their own. In two of these cases, the defect was a pure bitemporal hemianopsia. Central vision was reduced unilaterally in both. The third patient was blind in the right eye and had a defect involving less than the entire temporal field in the left.

In the collected cases, injury was usually to the frontal area and was usually the result of a blunt blow. Roentgenogram revealed no fracture in six cases. The sixth nerve was injured in 7 patients, and 7 presented unilateral blindness. The olfactory nerve was injured in five patients. Polyuria was present in 7 cases, in 2 of which it was transient. Traquair and his associates attributed the chiasmal damage in these cases to vascular injury rather than to sagittal tearing of the chiasm.

Osterberg,[10] in 1938, reported 2 cases and presented experimental studies on tearing of the chiasm in vivo; he was able to demonstrate multiple small tears. It was his opinion that the blood supply to the center of the chiasm is not separate from the supply to the lateral partitions, which would indicate that the crossed fibers would not be affected alone by damage to the blood vessels. He cited Coppez, who had also demonstrated multiple minute tears in the crossed fiber bundles. Osterberg also showed that separation of the optic foramina for a distance of 1.2 mm. by frontally applied force would produce tears because the optic nerves are firmly adherent to the foramina.

Henderson and Rucker,[11] in 1940, showed tearing of the chiasm in one case. In 1942, Burch [12] recorded a case in which a fracture of the sella turcica resulted in bitemporal hemianopsia. Vision on the right was 20/25 and on the left was limited to finger counting at 6 inches.

The accumulated evidence thus suggests that tearing of the chiasm does occur, although vascular damage must be considered as at least a contributory cause in these cases.

SUMMARY AND CONCLUSIONS

1. The best method of studying the cortical representation of different areas of the retina is by correlation of visual field defects with definitely known sites and types of head injury, operative findings, and roentgenologic examination of the skull. Such cases are not frequent except in time of war. The 12 cases recorded in this chapter are typical illustrations.

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[9] Traquair, H. M., Dott, N. M., and Russell, W. R.: Traumatic Lesions of the Optic Chiasma. Brain 58: 398–411, September 1935.

[10] Osterberg, G.: Traumatic Bitemporal Hemianopsia. Acta Ophth. 16: 466, 1938.

[11] Henderson, J. V., and Rucker, C. W.: Bitemporal Hemianopia of Traumatic Origin. Arch. Ophth. 24: 800–802, 1940.

[12] Burch, F. E.: Ocular Evidence of Head Trauma. Wisconsin M. J. 41: 1092–1097, 1942.

2. Cortical representation of the fixation area (macula) is similar to cortical representation of the peripheral portions of the retina. The fixation area is represented at the posterior tip of the occipital lobes, while the peripheral portions of the retina are represented in the cortex at the anterior end of the calcarine fissure. Intermediate points of the retina are represented between these two areas of the area striata.

3. Similarly, the upper half of the retina is represented in the cortex above the level of the calcarine fissure, and the lower half is represented below this level.

4. Neither the fixation area (macula) nor the peripheral areas of the retina have duplicate areas of representation.

5. It therefore follows that homonymous hemianopsia, vertical hemianopsia, and quadrant anopsia may occur in the peripheral field and that the central fields may also show homonymous scotomas which may be lateral or vertical, central or paracentral, and hemianopic or quadrantic. Combinations of homonymous hemianopsia and central scotomas also occur when missiles producing oblique wounds pass through the tip of one occipital lobe and through the occipital lobe or optic radiations on the opposite side, as was shown in 1916 by Holmes and Lister.[13]

6. Bilateral homonymous hemianopsia with sparing of the fixation areas, as illustrated in cases 8 and 9 in this series, represents the antithesis of bilateral central scotomas with normal peripheral fields. These cases support some of the statements in the conclusions already listed.

7. Bilateral hemianopsia is possible as the result of damage to the chiasm, though in these circumstances it is seldom "pure." The mechanism of the damage to the uncrossed fibers alone is not entirely clear.

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[13] See footnote 1, p. 307.

CHAPTER XVIII

Plastic Surgery of the Lids and Orbit

Arthur E. Sherman, M. D.

Because of the high incidence of wounds and burns about the face resulting from modern methods of warfare in World War II, numerous casualties required reconstructive surgery of the orbital area. This work was chiefly carried on in ophthalmic-plastic centers in the Zone of Interior. At three of the centers—Crile, Cushing, and Wakeman General Hospitals—the operations were usually performed on the general plastic service. At Dibble, Newton D. Baker, Northington, O'Reilly, and William Beaumont General Hospitals, reconstructive surgery of the ocular structures was done almost entirely by members of the eye service. At Valley Forge General Hospital, late implants and the repair of such conditions as ectropion and notches were usually carried out on the ophthalmologic service, while eyebrow grafts, total reconstruction of eyelids, and repair of defects of the orbital margin were usually delegated to the general plastic service.

Although the same basic policies and practices were employed at all ophthalmic-plastic centers, individual details of procedure varied in details in the different installations. In this chapter, the methods outlined are those followed at certain of the centers, while the details of management and case histories presented are reported from other of the centers.

NORTHINGTON GENERAL HOSPITAL

When Northington General Hospital was first activated as an eye center, the chief of the plastic-surgery section assisted members of the ophthalmologic service in the care of injuries of the eyelids and orbit. Because of the large number and heavy backlog in the plastic-surgery section, members of the ophthalmologic service gradually took over the care of all injuries which involved structures around the eyelids, orbital rims, and related regions.[1] The two services continued to work in cooperation in the management of large deformities involving the entire face.

The following general policies were observed:

1. Small notches were corrected by Wheeler's halving procedure.
2. Colobomas were corrected by the use of sliding and pedicle flaps.

[1] Lt. Col. Clement C. Clarke, MC, and Capt. Alston Callahan, MC, were chiefly responsible for the ophthalmic-plastic surgery.

3. Ectropions were corrected with free-skin grafts. In early cases treated at the center, the cephaloauricular angle served as the donor site but later the inner surface of the arm was preferred.

4. Entropions were preferably corrected by the utilization of a bridge of skin from the external surface of the lid. This bridge was brought over the lashes and sutured into an incision made posterior to the intermarginal line.

5. When transplantation of cilia was required, a free-skin graft of the eyebrow skin was used. It was usually selected from the ipsilateral side and was not rotated.

6. Deformities of the canthus were repaired by wiring the canthus to the bone with tantalum or stainless-steel wire.

7. Eyebrows were repaired by free grafting of areas of scalp of the proper size taken inferior to the occipital protuberance.

8. Reconstruction of the orbital rim was carried out in 19 cases by the ophthalmic surgeons alone and in 5 others with the assistance of plastic surgeons. Bone grafts, autogenous and homogenous cartilage grafts, tantalum plates, acrylic wedges, and acrylic plates were all used for this purpose.

9. Paralysis of the levator muscle, when the superior rectus muscle functioned well, was corrected, with excellent results, by Motais' operation. Fascial slings to the frontalis were used in some instances of levator paralysis, but, in cases of anophthalmos, resection of the levator was found to produce a better cosmetic result. Some cases of ptosis associated with anophthalmos were successfully treated by the use of a specially constructed plastic artificial eye.

10. The socket was reconstructed by various techniques. In one instance, skin from the anterior surface of the thigh was used, but the result was not regarded as satisfactory. In three cases, the penile mucous membrane was used, with good results. In six cases in which the conjunctiva was inadequate, use of a mucous-membrane graft from the inner surface of the cheek brought about considerable improvement.

CRILE GENERAL HOSPITAL

At the Crile General Hospital,[2] mucous-membrane grafts were used exclusively in instances of contracted eye sockets, mucous membrane apparently being superior to skin for use within the orbit. The tantalum-mesh technique, devised by Ruedemann, proved a satisfactory method of restoring orbital volume in a number of cases, but the material was expensive and was not always available. Preserved cartilage was therefore frequently substituted.

The cartilage to be preserved was thoroughly cleaned, and all perichondrium was removed. It was placed in 50 percent alcohol for 24 hours, and then transferred to a solution consisting of 1 pint of aqueous Merthiolate and 2

[2] Lt. Col. Gilbert C. Struble, MC, was chiefly responsible for the ophthalmic-plastic surgery.

quarts of physiologic salt solution. This solution was changed weekly, and a culture was taken at the time of each change. Absolute sterility was observed throughout every procedure, and the cartilage was always handled with sterile forceps which had not been in contact with Lysol or alcohol.

Orbital restoration was greatly simplified if orbital tracings taken from X-rays were available at the time surgery was performed. In cases in which the eye had been enucleated, it was found advantageous to enter the orbit through the old conjunctival incision in the horizontal meridian. Tenon's capsule was elevated, with or without an implant, and the dissection was carried to the orbital wall shown to be abnormal by the tracings. The preserved cartilage was properly trimmed and fitted into position, and closure was effected in the usual manner. When this technique was employed, no skin incision was required, and there was little or no danger of entering the nasal cavity or the sinus spaces.

Skin defects which had resulted in ectropion were corrected by full-thickness skin grafts, usually taken from behind the ear or from the supraclavicular fossa, in which areas the skin is of a proper texture and pigmentation to match the skin of the eyelids. Tarsorrhaphy was performed routinely in these cases.

Ordinary notching defects were corrected by Wheeler's halving technique or by Hughes' tongue-and-groove operation. Excessive sagging of the lower lid responded best to the Kuhnt-Szymanowski procedure. The Blaskovicz procedure was used almost exclusively for the correction of ptosis, with extremely satisfactory results. Depressed sulci of the upper lid usually could be corrected satisfactorily by means of a glass-ball implant into Tenon's capsule, or, if such an implant had already been used, by the insertion of a preserved cartilage graft well back in the floor of the orbit. The clinical impression that in cases of this kind a large proportion of the deformities incurred in combat were caused by undiagnosed depressed fractures of the orbital floor was confirmed by routine orbital tractings.

WILLIAM BEAUMONT GENERAL HOSPITAL

At William Beaumont General Hospital, although the ophthalmic service [3] was chiefly responsible for reconstructive surgery of the eyelids and orbit, there was close cooperation with the plastic service. The staff of this service assisted in the care of all extensive defects and also assisted, regardless of the extent of the injury, when the number of patients was large. The casualties concerned were assigned to a special ward, on which weekly rounds were made by the chiefs of both services. At these rounds, decisions were made concerning treatment, particularly when cartilage or bone grafts, fascia lata transplants, and split-thickness grafts for sockets were required. The plastic and oph-

[3] Lt. Col. O. W. Thoeny, MC, and Maj. G. A. Filmer, MC.

thalmic-plastic surgeons usually operated on these patients together. Implant cartilage was obtained from a cartilage bank operated in cooperation by the two services.

At the William Beaumont General Hospital Eye Center, preoperative preparation underwent several changes as the war progressed. Originally, patients were prepared on the ward 24 hours before operation. Preparation included thorough washing of the area with soap and water, sponging with alcohol, and painting with one of the usual antiseptics. The area was then covered with a sterile dressing. This method proved unsatisfactory for several reasons: (1) It was difficult to keep the areas about the eye clean for 24 hours, particularly if the socket was deformed or discharging; (2) ward personnel frequently changed, so that it was necessary repeatedly to teach new personnel how to get patients ready for operation, with the result that the sterile technique was not always as careful as it should have been; and (3) sterile dressings frequently came off during the night, and, even if they remained in place, the patients were likely to contaminate the operative field.

The following preoperative preparation was therefore substituted for the original method: The operative field was cleansed with soap and water and shaved 48 hours before operation. No dressings were applied. Final preparation was carried out in the operating room just before operation. The operative field was cleansed with soap and water, sponged with alcohol, and painted with whatever antiseptic was preferred. If a skin graft was contemplated, the area was also sponged with ether to remove sebaceous secretions. This method was found simple and expeditious, and no significant postoperative infections occurred when it was used.

Standard methods were used in most injuries and deformities. Excellent results were obtained from the transplantation of eyebrow lashes to the eyelid. A vertical incision was made in the brow at a point at which the length of the cilia equaled the desired length of the eyelashes. The graft was then placed horizontally in the previously prepared bed in the eyelid, with the cilia directed upward or downward as desired.

Transplants were carried out on many patients who had been subjected to numerous previous attempts to correct pterygia. It was found that recurrence of the condition was unlikely if the pterygium was freely dissected from its base and retracted, and a pedicle of conjunctiva, taken from a horizontal position above or below the cornea, was placed in a vertical position in the defect. The essential portion of this technique was the proper placement of the formerly horizontal strip of conjunctiva.

Case Histories

The following case histories illustrate representative problems encountered on the ophthalmic-plastic service at Beaumont General Hospital and the methods used to solve them.

Case 1.—This officer suffered a severe laceration of the left orbit and loss of the left eyeball in a plane crash in New Guinea on 14 June 1944. A portion of the orbit was lost. He was told that the frontal lobe had been exposed immediately after injury, that there had been a free flow of spinal fluid, and that he had been unconscious for several hours. The first treatment, at a portable hospital, consisted of removal of the remnants of the left globe and suture of the wounds. He eventually arrived at the William Beaumont General Hospital 1 September 1944.

Examination at the time of admission showed a considerable loss of structure about the left orbit, particularly over the superior portion. The globe was absent, and only a fragment of the lower lid and conjunctiva remained in situ (fig. 59A).

No reconstructive surgery was considered feasible, and the remaining portion of the left lower lid and the small remnant of conjunctiva were therefore excised 11 October 1944.

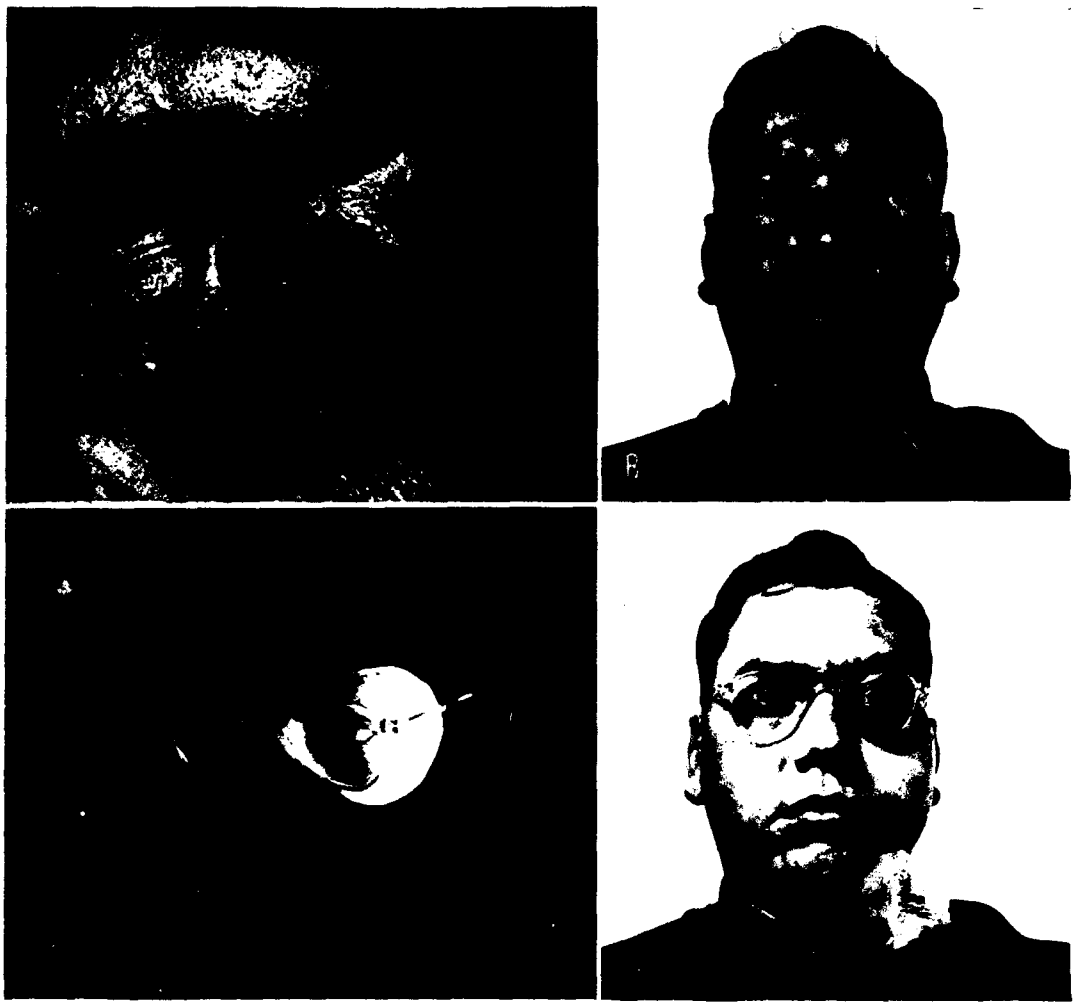


FIGURE 59.—**A.** Loss of structure about left orbit, particularly over superior portion. The globe is absent, and only fragments of the lower lid and conjunctiva remain in situ. B. Defect shown in A, after excision of remnant of conjunctiva and application of full-thickness graft. C. Prosthetic device constructed to correct defect shown in B. D. Prosthetic device in situ.

The defect was filled with a full-thickness graft secured from behind the ear. When this area had healed (fig. 59B), a prosthetic appliance was made (fig. 59C) and the patient was discharged to duty at his own request. The defect was not at all conspicuous when the prosthesis was in place and glasses were worn (fig. 59D).

Case 2.—The patient was injured in action by the explosion of an enemy high-explosive shell in Italy. He sustained wounds of the right thigh in addition to wounds of the face and the right eye. The injury of the eye resulted in intraocular hemorrhage and vascularization of the cornea, together with a defect of the upper lid which later resulted in a traumatic coloboma.

Examination at William Beaumont General Hospital on 6 June 1944 showed a notch defect in the right upper eyelid (fig. 60A). The eye was soft and slightly smaller than normal. The cornea was densely vascularized. There was no evidence of uveitis at this time, and the eye appeared quiet.



FIGURE 60.—A. Notch defect of right upper eyelid, soft eye, slightly smaller than normal, and densely vascularized cornea following injury by high-explosive shell. B. Defects shown in A, 3 months later, after plastic correction.

Treatment was first directed to the colobomatous defect in the upper lid. A two-stage operation materially reduced the notch. The cornea was then tattooed for cosmetic reproduction of the pupil. Later, lashes were transplanted from the eyebrow to the notch defect (fig. 60B). The patient was well satisfied with the cosmetic end result.

Case 3.—This patient, who was almost ready for retirement on length of service, had been treated intensively for syphilis and neurosyphilis for a number of years. In March 1944, he was admitted to the station hospital on his post because of headaches, dizziness, marked fatigue, intense nervousness, anxiety about many things, feelings of insecurity, and the fear that he was losing his mind. He did not improve, and while visiting his home on 18 April 1944 he attempted suicide by placing the muzzle of his gun in his mouth. The resultant blast passed upward through the left maxillary region and the left orbit and out through the frontal area. The remnants of the left eye were removed and the defects were sutured at the station hospital; he was transferred to the William Beaumont General Hospital 24 May 1944.

Examination at the time of admission showed a defect in the maxilla at the left anterior dental arch (fig. 61A). This defect continued upward, with exteriorization of the left maxillary antrum, along the nasolabial fold. A large triangular defect involved practically the entire lower lid. The left globe had been removed.

The first plastic procedure was carried out 14 July 1944. An incision was made through the skin, extending from the inner end of the left lower lid downward along the nasolabial fold and curving laterally to the left corner of the mouth at the lower nasal ala. The skin of the cheek was undermined and rotated upward, so that the lateral line of the defect became the lower border of the reconstructed lower lid. The skin edges were sutured with interrupted horsehair sutures, and a pressure dressing was applied.



FIGURE 61.—A. Defect of maxilla and large triangular defect of left lower lid following suicide attempt. The globe has been removed. B. End results of plastic repair of defect of left lower lid and of maxillary defect. This picture was taken 9½ months after injury and 2 months after the last plastic operation.

The results of this operation were excellent, except for a residual defect at the internal canthus. On 6 October 1944, a Z-plasty was carried out on dense scar tissue in the area of the inner canthus. This procedure improved the defect, but additional plastic surgery was necessary 3 months later. At that time, the inner canthus was reconstructed, and new lashes were placed in the lower border of the reconstructed lid. An acrylic prosthesis was supplied. The final result (fig. 61B) was considered satisfactory from both the cosmetic and the functional standpoint.

Case 4.—The patient was wounded in action in Belgium 2 October 1944 by fragments of an exploding enemy shell. In addition to injuries of the left shoulder and left arm, he sustained injuries of the left eyeball and left lower lid. He reached Beaumont General Hospital 17 December 1944.

At this time, he presented, in addition to his other injuries, a deformity of the left lower eyelid and a traumatic choroiditis of the left eye (fig. 62A).

On 22 December, a plastic repair of the notch defect in the left lower lid was accomplished under local analgesia, by means of a Hughes sliding graft. The cosmetic result was good (fig. 62B). On 24 March 1945, the absence of lashes was corrected by transplantation of a vertical strip from the right eyebrow. This strip was placed horizontally into the area of the left lower lid, which was devoid of lashes. Within 6 weeks, a satisfactory growth of lashes was obtained (fig. 62C). The patient was eventually separated from service because of a fibrous ankylosis of the left shoulder joint.

When this type of plastic surgery was necessary, in addition to restoration of the lashes, particular attention had to be paid to the lacrimal canaliculus and to the curvature of the lid, so that a proper tear lake would be maintained.



FIGURE 62.—A. Notch defect of left lower eyelid and traumatic choroiditis of left eye 2½ months after battle injury. B. Result of repair of defect shown in A, by means of Hughes' sliding graft. This picture was taken 3 months after operation. C. End result of repair of defect and restoration of eyelashes. This picture was taken approximately 6 months after the first plastic operation and approximately 8 months after injury.

BAKER GENERAL HOSPITAL

At Baker General Hospital, deformities in and about the orbit were handled on the ophthalmologic service unless bone grafts were required. When they were necessary, ophthalmologic and plastic surgeons handled the case together.[4]

In socket reconstructions, epidermal grafts were used whenever the defect was more than half the size of the socket. The grafts were obtained by means of a Padgett dermatome, and the skin was wrapped around an acrylic conformer. A series of these conformers, in a variety of sizes, was prepared in the acrylic laboratory. When the defect did not exceed half the size of the socket, a mucous-membrane graft from the buccal mucosa was employed. Generally speaking, split-skin grafts were more satisfactory and were associated with less shrinkage than mucous-membrane grafts (fig. 63).

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[4] Lt. Col. Sidney A. Fox, MC, was chiefly responsible for the ophthalmic-plastic surgery.



FIGURE 63. A. Loss of right eye, with blepharophimosis and loss of outer half of socket following shell-fragment wound in France on 1 August 1944. B. Appearance of patient after (1) reconstruction of socket on 6 December 1944, and (2) external canthoplasty on 7 February 1945.



FIGURE 64. A. Loss of left eye, with cicatricial lagophthalmos and loss of outer half of margin of upper lid following shell-fragment wound of head, left eye, and right leg in Germany 28 January 1945. B. Appearance of patient after (1) Z-plasty and transplant of external canthal ligament on 31 May 1945, (2) lash graft of left upper lid on 23 July 1945, and (3) opening of tarsorrhaphy on 12 September 1945.

Small notches in the eyelids were repaired by the Wheeler halving procedure. Tarsoconjunctival sliding grafts from the apposed lid were used for more extensive defects. Lash grafts, which were frequently used, were obtained from the eyebrow (fig. 64).

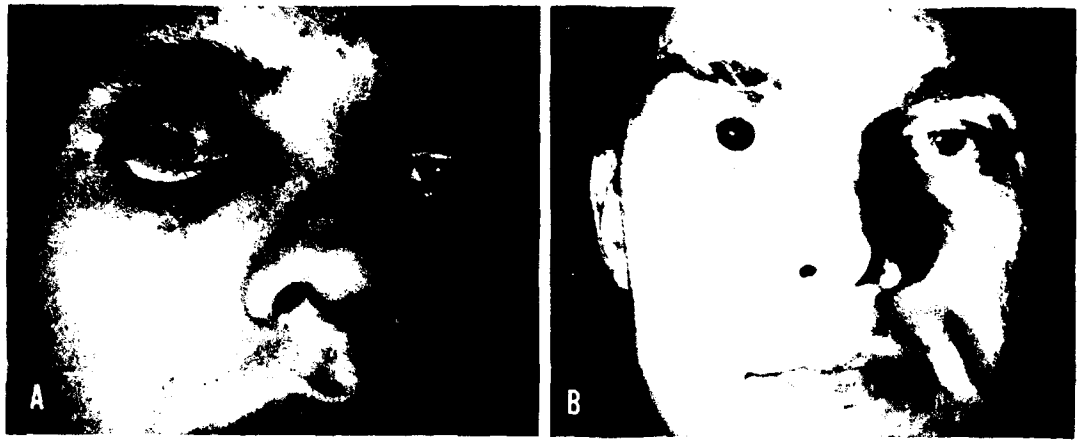


FIGURE 65. A. Loss of right eye and upper lid, entropion of lower lid, excoriation of orbit, and fractures of all walls of orbit following bullet wound on Luzon on 11 April 1945, which resulted in a penetrating wound of the right eye, fracture of the orbital bones, and laceration of the right frontal lobe of the brain. B. Appearance of patient after (1) delayed pedicle flap lifting right brow, 11 July 1945; 2 rotation of pedicle with suture below right brow, 27 July; (3) split-skin graft to socket, 12 September; (4) free-skin graft to widen lid, 17 October; and (5) repair of entropion of right lower lid, 1 November 1945.

Lid reconstructions were generally carried out by rotated or sliding pedicles from the immediate vicinity (figs. 65 and 66). Whole-skin grafts were also used, as was the Hughes procedure (fig. 67).

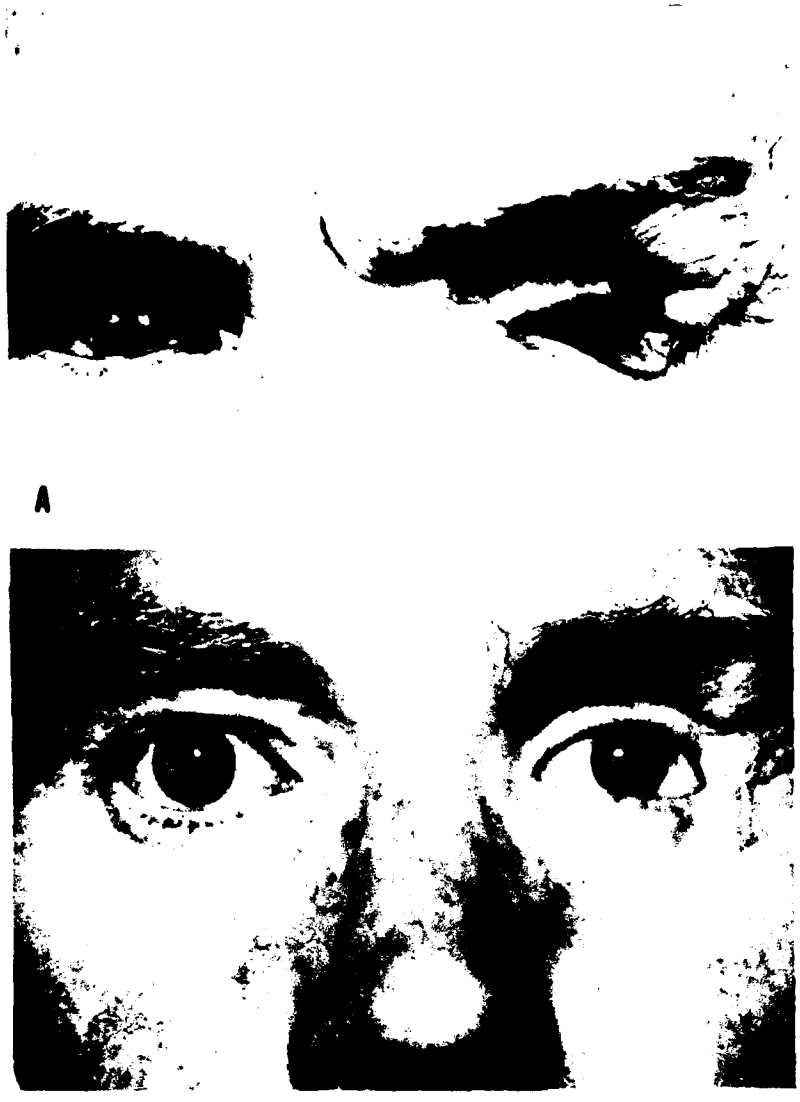


FIGURE 66. A. Loss of left eye and of temporal halves of upper and lower lids following machinegun-bullet wound on Saipan on 26 June 1944. B. Appearance of patient after (1) blepharoplasty with preserved cartilage graft and two pedicle flaps; (2) opening of tarsorrhaphy, 3 May 1945, and (3) external canthoplasty, 26 March 1945.

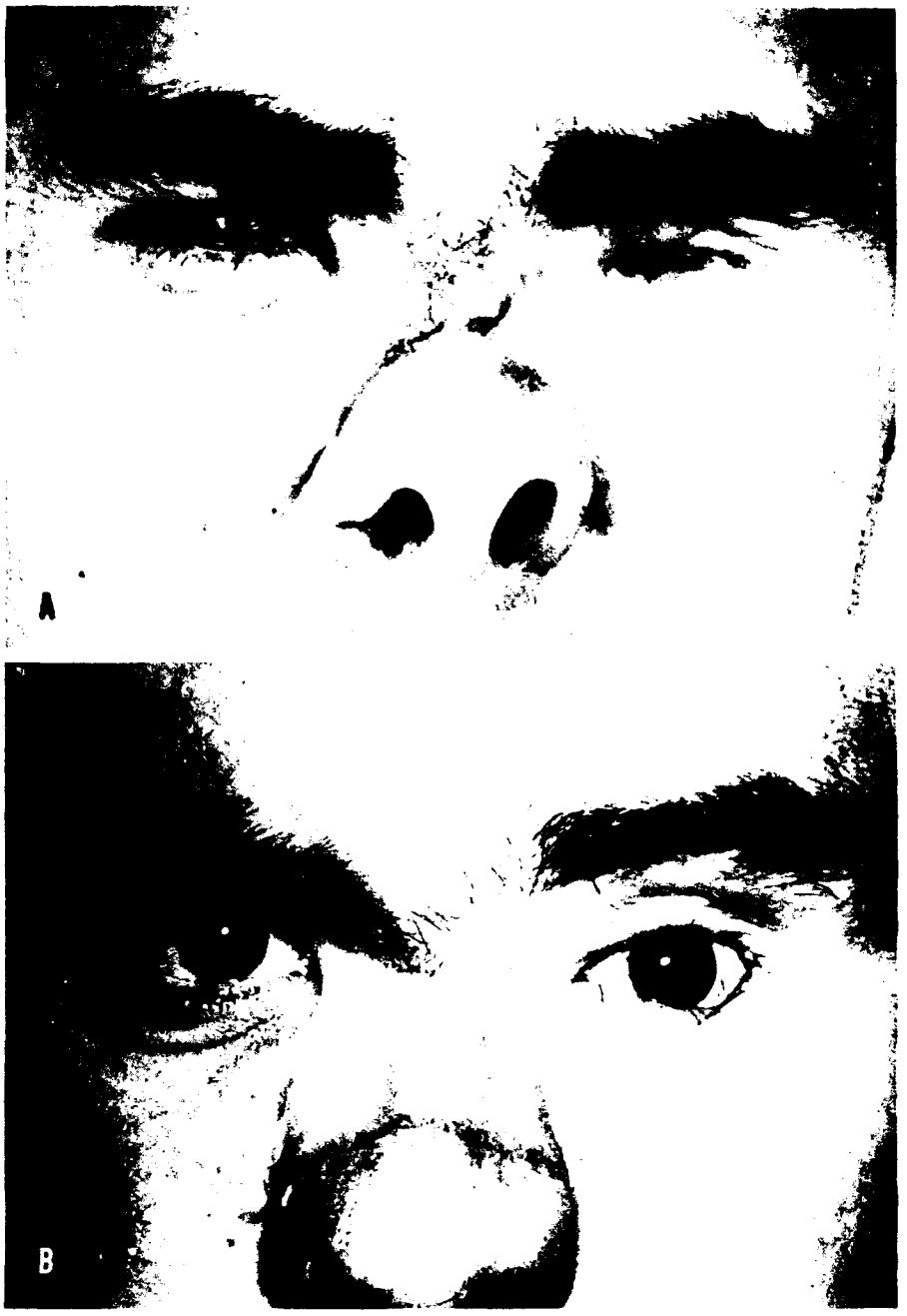


FIGURE 67. A. Loss of left eye and of free halves of left upper and lower lids following injury of nose and left eye by shell fragments in France on 10 August 1944. B. Appearance of patient after (1) blepharoplasty with skin graft, 17 November 1944; (2) lash graft to left lower lid, 7 May 1945; (3) lash graft to left upper lid, 31 August 1945; and (4) opening of tarsorrhaphy, 11 October 1945.

Cicatricial ectropion and lagophthalmos were usually corrected with whole-skin grafts from the lid, the cephaloauricular region or the supraclavicular region (fig. 68). If these sources were not available, the graft was obtained from the medial surface of the upper arm.



FIGURE 68. A. Loss of left eye, avulsion of left lower lid from internal canthus, and fracture of walls of left antrum and orbital floor following shell wound in France on 2 August 1944. B. Appearance of patient after (1) plastic repair of laceration, 6 December 1944; (2) free-skin graft to left lower lid, 6 March 1945; (3) secondary orbital implant, 18 April 1945; and (4) external canthoplasty, 12 July 1945.

Deformities of the orbital margins were repaired with preserved cartilage and fascia lata grafts. Ptosis of the orbital contents was corrected by grafting preserved cartilage to the orbital floor. Unsightly depressions of the upper lid following enucleation were corrected with fascia lata grafts. In cases of congenital and traumatic ptosis, the Blaskoviez and Reese procedures were favored (fig. 69).



FIGURE 69. A. Loss of left eye, ptosis of upper lid, and avulsion of external canthus following shell-fragment wound in France on 28 August 1944. The missile entered the nasal bridge on the right and made its exit through the left orbit. B. Appearance of patient after (1) secondary orbital implant, 8 November 1944; (2) Blaskoviez operation on left upper lid, 1 December 1944; (3) incision and drainage for left acute dacryocystitis, 19 January 1945; (4) left dacryocystorhinostomy, 7 March 1945; and (5) transplant of left external canthus upward, 25 April 1945.

O'REILLY GENERAL HOSPITAL

From June 1944 to January 1946, approximately 700 plastic operations were performed on approximately 400 patients admitted to O'Reilly General Hospital for the correction of defects of the eyelids and the orbit. These operations were carried out by members of the ophthalmologic staff under the supervision of a qualified ophthalmic-plastic surgeon.

Anesthesia, Preoperative and Postoperative Care

Routine preoperative preparation was, in general, similar to that for any other eye surgery. A hypodermic injection of morphine, 16 mg., and scopolamine, 0.65 mg., was given 30 minutes before operation.

General anesthesia, preferably Pentothal Sodium (thiopental sodium) by the intravenous route, was used for late implants to the orbit, for epidermal grafts to reline the socket, and for the filling of small depressions with fascia lata. Endotracheal ether anesthesia was used for more extensive operations, such as iliac-bone grafts to the orbital margin. Local anesthesia (Pontocaine 0.5 percent for eye drops, procaine hydrochloride 2 percent for skin infiltration) was used for procedures such as full-thickness skin grafts, eyelash or eyebrow grafts, reconstruction of the eyelids, and similar operations. If the patient was given Nembutal 0.1 gm. by mouth about an hour before operation, in addition to morphine and scopolamine in the doses mentioned, he usually slept through an operation performed under local analgesia.

For all except minor procedures, the Pfeiffer modification of the Wheeler pressure dressing was applied after operation. It was usually left in place for



FIGURE 70.—A. Avulsion of left lower eyelid, corneal opacity, occlusion of pupil, and traumatic amblyopia following shell wound sustained in aerial combat over Germany on 25 February 1945. B. Appearance of patient after (1) repair of eyelid, 10 October 1945; and (2) tattoo of cornea, 9 November 1945.

6 days and, after the tension sutures had been removed, was reapplied in all instances of free-skin graft, orbital implants, bone grafts, and similar operations. The other sutures were removed on the 9th or 10th day, and the pressure dressing was not reapplied. This type of dressing was found to be particularly valuable in all instances in which grafts had been done. In one such case, the patient, who had been treated by free-skin graft, had a postoperative hemorrhage sufficient to saturate the dressing on the 8th day after operation. The dressing was merely reinforced and left in place until the 10th day. When it was changed, the grafts were found to have taken well, and there was no evidence of blood clot under them (fig. 70).

Technical Procedures

Surgery of the eyelids.—A rather common deformity of the eyelid, resulting from laceration through the lid margin, took the form of a notch of the margin with an accompanying vertical scar. The most satisfactory correction



FIGURE 71.—A. Loss of left eye, vertical scars of eyelids with notching of lid margin and some cicatricial contracture of lower socket in region of scar through eyelid. This patient had sustained his injuries from a mine fragment on 21 May 1945; enucleation of the eye and suture of the eyelids had been performed the same day. B. End result in November 1945, following (1) excision of scar of both eyelids, with halving type of repair, on 13 September 1945, and (2) further excision of scar of upper nasal portion of upper eyelid 1 month later.

of this type of deformity was by excision of the notch and scar through the entire thickness of the eyelid and approximation of the defect by Wheeler's halving operation (figs. 71 and 72). Larger defects or traumatic colobomas, which caused losses up to a third of the eyelid, were corrected similarly by releasing the lid laterally by means of an extended lateral canthotomy, plus severance of the tarsal attachment to the lateral ligament (fig. 73).

When the lower eyelid had been torn from its attachment to the medial canthal ligament, with little loss of lid substance, and had healed in a drawn-



FIGURE 72. A. Dense linear scars of nasal third of both right eyelids with notch of margins and some ectropion of lower eyelid on 20 October 1944, 40 days after the patient had sustained a lacerated wound of the right eye, eyelids, and cheek, with fracture of the zygoma and maxilla, from shell fragments. B. End result in October 1945 following (1) excision of scar of upper eyelid and halving type of repair in December 1944; (2) a similar procedure on the lower eyelid in January 1945; (3) excision of additional scar tissue of lower eyelid, skin graft from upper eyelid, and lid adhesion in February 1945; (4) repetition of the latter procedure in May 1945 because the lid adhesion did not hold; and (5) cutting of lid adhesion and fitting of prosthesis in October 1945.

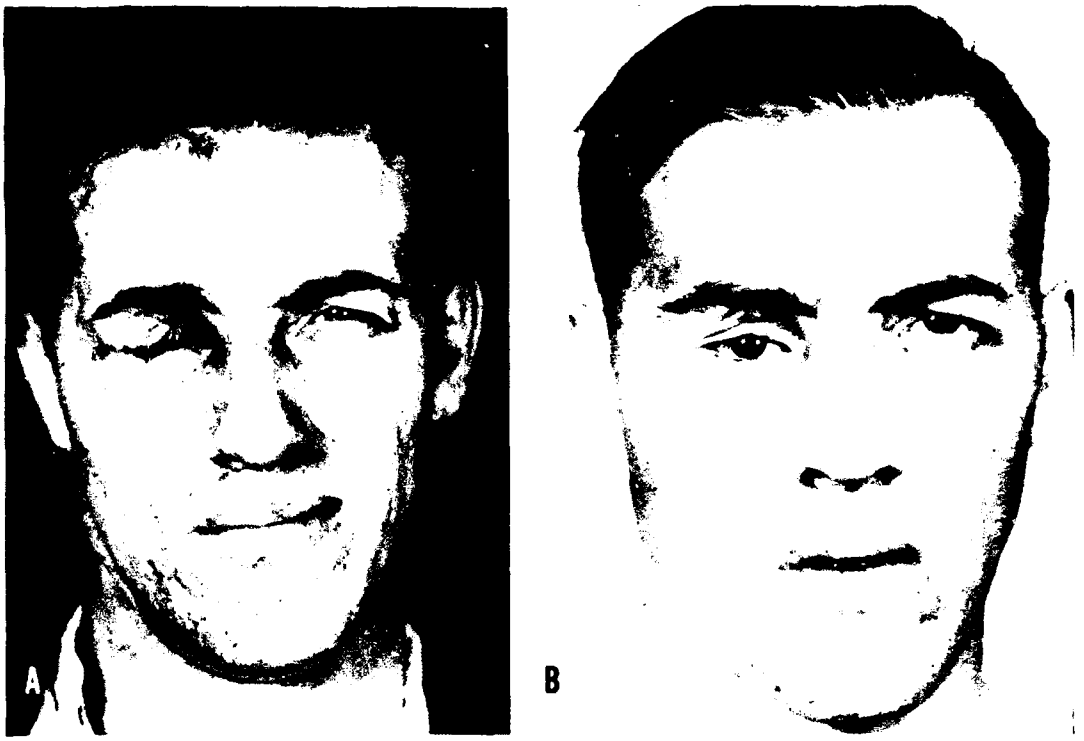


FIGURE 73. A. Loss of middle third of right upper eyelid, with mass of granulomatous tissue projecting through defect and adherent to it on 30 August 1944. This patient had sustained multiple penetrating wounds, including wounds of the right eye and upper eyelid, from grenade fragments on 4 July 1944; the eye was enucleated the same day. B. End result following 1, excision of granulomatous tissue of upper enlebessae in November 1944; 2, closure of defect of upper lid by halving technique with extended canthotomy and freeing of lateral end of upper tarsus from ligament in January 1945; 3, excision of scar tissue of upper socket and mucous-membrane graft from inner surface of lower lip in July 1945; and 4, fascia lata graft applied as filling below brow in September 1945.

down position, it was customary to follow Wheeler's technique of excision of scar tissue. The eyelid was thoroughly mobilized, and a small tongue of tarsus was denuded at the nasal end of the lid and anchored into a pocket below the carunele to the canthal ligament with a mattress suture tied through a piece of rubber on the skin surface. By this technique, tension is taken up by the more temporally placed sutures, and the nasal end of the lid lies in a position of slight overcorrection without tension (fig. 74).

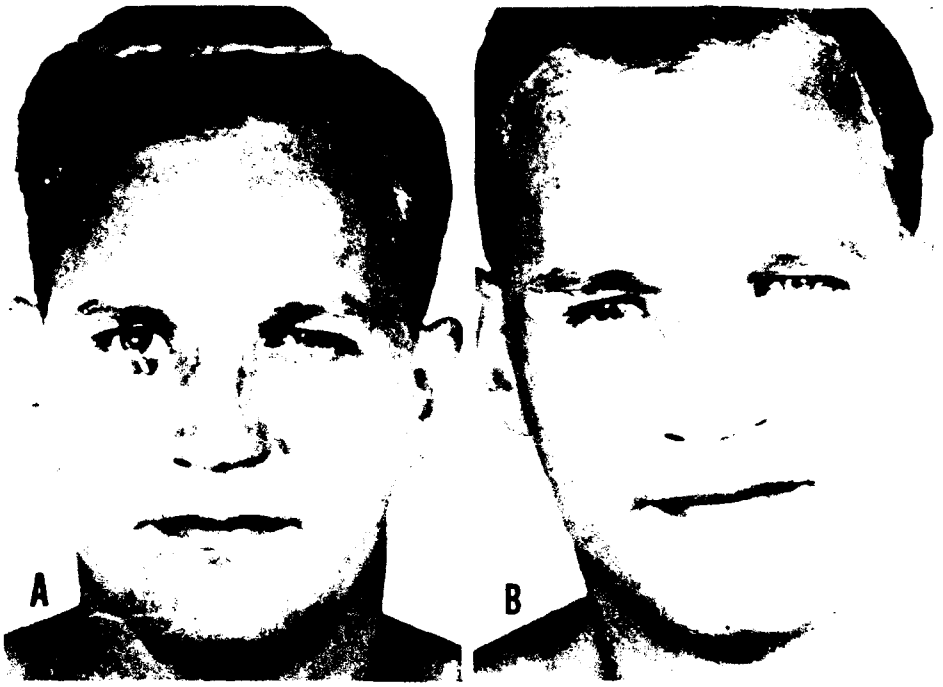


FIGURE 74. A. Laceration of right eye and lower eyelid and compound fracture of nasal bones in May 1945, following injury by shell fragment on 26 January 1945; the right eye was enucleated the same day. Note that the nasal end of the right lower eyelid has been torn from the canthal ligament and has partially curled back on itself in the course of healing. B. End result following mobilization of the nasal half of the lower eyelid and reattachment to the canthal ligament of a tongue of tarsus formed on the nasal end in July 1945.

Cicatrical ectropion or lagophthalmos resulting from burns was frequently observed during World War II, especially in members of the Army Air Forces and armored units. It was also observed in foot soldiers injured by boobytraps of black powder and similar devices. Ectropion also resulted from lacerated wounds in the region of the eyelids (figs. 75 and 76).

These defects were usually corrected by the technique perfected by Wheeler, which utilizes a full thickness or Wolfe graft in a bed prepared by thorough excision of scar tissue, plus the use of intermarginal lid adhesions for 2 or 3 months. Almost without exception, ophthalmic surgeons thought that



FIGURE 75. A, Cicatricial ectropion of right lower eyelid, 8 January 1945, following severe laceration incurred in jeep accident on 8 November 1944. B, End result following (1) excision of scar of lower eyelid, Wolfe graft from upper eyelid and two lid adhesions (7 February 1945), (2) severing of lid adhesions 2 months later and revision of scar of lateral cheek (carried out on plastic-surgery service).

there was no indication in the correction of these defects for the employment of pedicle skin flaps from surrounding areas, for Esser epidermal inlays, or for Gillies epithelial outlays, though all of these methods had been extremely popular following World War I. By the Wheeler technique, the full-thickness graft is taken from the upper eyelid whenever possible (fig. 77). Skin from the postauricular angle is the second choice (fig. 78). These grafts, which need not be larger than the defect, must be handled with a minimum of trauma and must be carefully sutured in place. At the O'Reilly General Hospital, when neither of these donor sites was available, skin from the supraclavicular area proved fairly satisfactory (fig. 79). Pressure dressings were particularly useful in this type of case. There was often a tendency for grafts applied by this technique to undergo some contraction during the first month after their application, but during the second and third months they usually returned to their original size and texture.



FIGURE 76. A. Severe ectropion of left lower eyelid on 29 October 1944, following shell-fragment wound of left cheek, nose, and upper lip, and fracture of nasal bones and both maxillae; initial repair at overseas general hospital. B. Appearance of patient in December 1945, following 1 large Wolfe graft from upper eyelid to lower eyelid with lid adhesions in March 1945, and 2 re-forming of one lid adhesion and addition of small skin graft in April 1945. The nasal lid adhesion had not been cut when this picture was taken, because further plastic work was to be done on the plastic service.



FIGURE 77.—A. Cicatricial ectropion of right upper eyelid with some loss of lateral half of eyebrow, 7 July 1945, following second- and third-degree burns of forehead and eyelid when plane was shot down over Italy on 16 July 1943. The patient had been a prisoner of war since. B. Appearance of patient in January 1946, with eyes closed, following (1) Wolfe graft from left upper lid to right upper eyelid with two lid adhesions (18 October 1945), and (2) separation of eyelids and eyebrow graft in January 1946.



FIGURE 78.— A. Severe ectropion of both right eyelids and cicatricial lagophthalmos of left eyelids on 1 March 1945, as result of burns sustained when a B-24 was shot down on 26 April 1944; the patient was a prisoner of war for 9 months afterward. B. Appearance of patient in November 1945 following (1) Wolfe grafts of postauricular skin to right eyelids, with three lid adhesions, in March 1945 and a similar procedure on the left side 8 months later. The lid adhesions were not cut because additional surgery was to be done about the nose and lips on the plastic-surgery service.



FIGURE 79. A. Cicatricial ectropion of both lower eyelids, following burns of face when tank destroyer was struck by enemy shell on 14 October 1944. This photograph was taken 2 weeks following correction of ectropion by full-thickness skin grafts from supraclavicular area, 5 February 1945. B. Final result in July 1945, following separation of lid adhesions in June.

Subtotal or total loss of the lower eyelid was a not uncommon type of deformity from shell fragments or bullet wounds. The Hughes method of reconstruction gave excellent results when little more than the tarsal portion of the lid was missing and was also the method of choice when the loss extended to the lower orbital margin. For these more extensive losses, it was sometimes found advantageous to begin the procedure by elevating the skin and underlying subcutaneous tissue by means of sliding flaps (fig. 80). At a second operation, the skin and the remnants of the conjunctiva were joined to the upper tarsus by the Hughes procedure. After this stage, a free-skin graft from the upper to the future lower eyelid was found helpful in elevating the future eye fissure. When there was a loss of the lower or lateral margin of the orbit, a bone graft from the crest of the ilium gave the most satisfactory end results. This procedure was carried out before the eyelid fissure was reopened. The most satisfactory eyelash grafts were taken from the midportion of the eyebrow just nasal from the center (fig. 81). The grafts were taken as 3-millimeter-wide strips and included about 4 rows of hair. Grafts for the lower eyelid were taken from the opposite eyebrow and turned in the opposite direction.

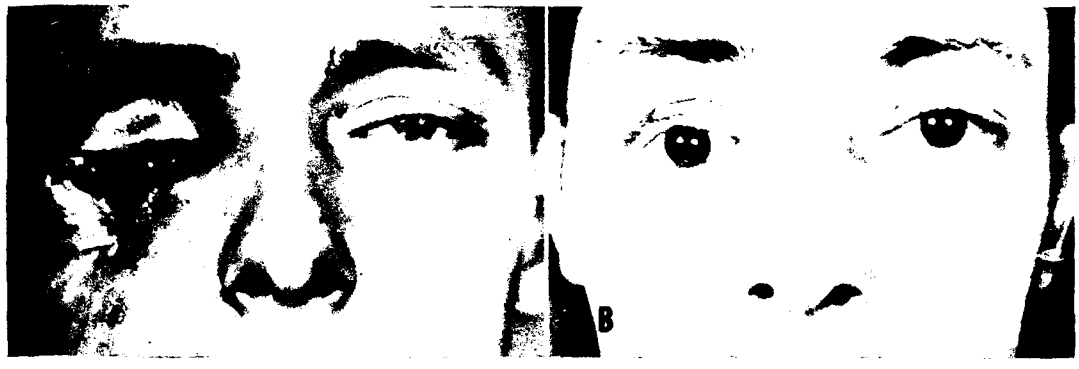


FIGURE 80.—A. Loss of entire right lower eyelid, with conjunctiva and skin adherent to remains of lower orbital margin and broad irregular scar temporal from missing lateral canthus, 15 January 1945. This patient had sustained a shell-fragment wound of the right eye, with avulsion of the lower eyelid, 24 November 1944; evisceration was carried out 1 December. B. Appearance of patient following (1) elevation of skin and conjunctiva below by sliding skin flaps (large flap with base temporal, small flap with base nasal), February 1945; (2) first stage Hughes' operation to join skin and conjunctiva from below to upper lid in May 1945; (3) Wolfe graft from upper to lower lid in August 1945; (4) eyelash graft to lower eyelid in October 1945; (5) iliac-bone graft to lower orbital margin in January 1946; (6) wedge acrylic implant to floor of orbit and mucous-membrane graft from mouth to lower temporal eye socket in May 1946; (7) fascia lata graft below brow for filling depression in June 1946; and (8) lateral canthoplasty in June 1946.



FIGURE 81. A. Loss of left eye and of middle two-thirds of tarsal portion of upper eyelid, 12 November 1944, following injury by ricocheted bullet on 9 August 1944. The eye was enucleated and a small split-skin graft was applied to the upper eyelid in a Polish hospital in Italy shortly after injury. B. Appearance of patient in July 1945 after (1) joining of eyelids by first stage of Hughes' procedure on 27 December 1944; (2) eyelash grafts 2 months later, (3) replacement of split-skin graft with Wolfe graft from right upper eyelid 2 May 1945; and (4) separation of lids and application of prosthesis in July 1945.

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Free grafts from the occipital part of the scalp, about ¼-inch wide, gave satisfactory results in about half the cases in which additional eyebrows were required (fig. 77) but failed in the other half; the grafts took, but the growth of hair was sparse or otherwise unsatisfactory.

Deformities of the eyebrow were usually best corrected by the Z-plasty procedure or by the interposition of flaps (fig. 89).

Most instances of traumatic ptosis of the upper eyelid were satisfactorily corrected by resection of the levator and tarsus. It was always well to wait 6 or 7 months in such cases, for natural recovery could occur (figs. 82 and 83).

Spontaneous recovery was also possible in seventh-nerve paralysis. If recovery did not occur, a simple lateral tarsorrhaphy was performed, or lid adhesion was used to protect the eye. In instances of loss of the eye, two lid adhesions were used to give support to the lower eyelid until orbicularis function returned. In permanent seventh-nerve paralysis, when the eyeball



FIGURE 82. A. Persistent ptosis of right upper eyelid, 28 June 1945, following penetrating shell-fragment wound through right eye and orbit into brain on 25 December 1944. The eye was enucleated overseas, and a fragment was removed from the brain. In April 1945, an acrylic prosthesis was fitted in the Zone of Interior. B. Final result in September 1945, following resection of tarsus and levator 4 weeks earlier.

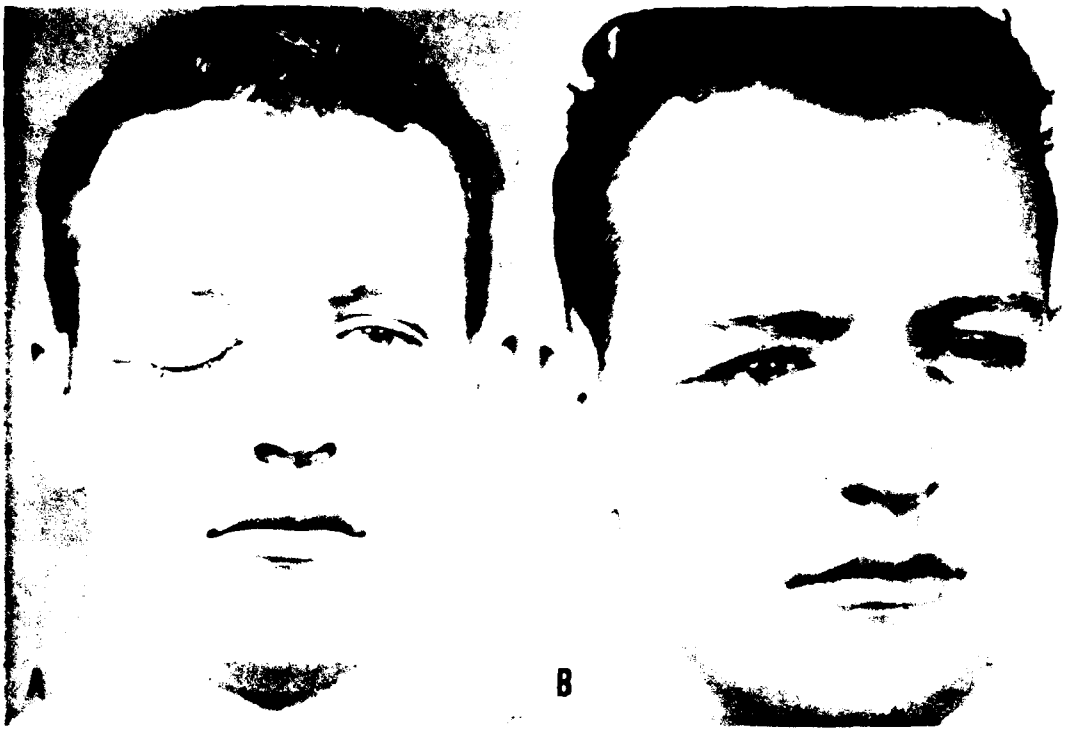


FIGURE 83.—A: Complete ptosis of edematous right upper eyelid, edema of upper socket and orbital depressed scar toward the temple from lateral cicatrix, 20 May 1945, following skull fracture wound of right eye and orbit on 15 March 1945, with comminuted compound fracture of frontal bone, zygoma and maxilla. The eye was enucleated the following day. B: Lateral view, 19 December 1945, following 1, removal from lateral upper orbital configuration of bone fragment, 4 July 1945, which was overlapping on lateral portion of socket; 2, resection of levator and ptosis, 5 September 1945, when it was evident that very little levator function would return; 3, fascia lata graft to fill depression in area of lateral orbital margin, 19 October 1945. Note that there is still some edema of the lateral portion of the eyelids.

was present, an operation devised by Wheeler was found to be quite satisfactory. It consists of a 5- to 6-mm. lateral canthoplasty supplemented by a liberal transplant of the lateral ligament farther temporally and excision of a vertical semilunar piece of skin lateral to the canthus.

In relaxation of the lower eyelid resulting from seventh-nerve paralysis or from long wearing of a large prosthesis in a socket without an implant, the Kuhnt-Szymanowski procedure for senile ectropion proved useful.

Surgery of the canthus. Battle-incurred deformities of the medial canthal area, except for cicatricial epicanthus resulting from burns, were usually accompanied by fractures of the orbit in this region and were difficult to correct. Often the attempt was made to anchor the canthal ligament in a position of overcorrection, but to accomplish this satisfactorily, the tear sac usually had to be excised. At times, it was also necessary to remove bone which

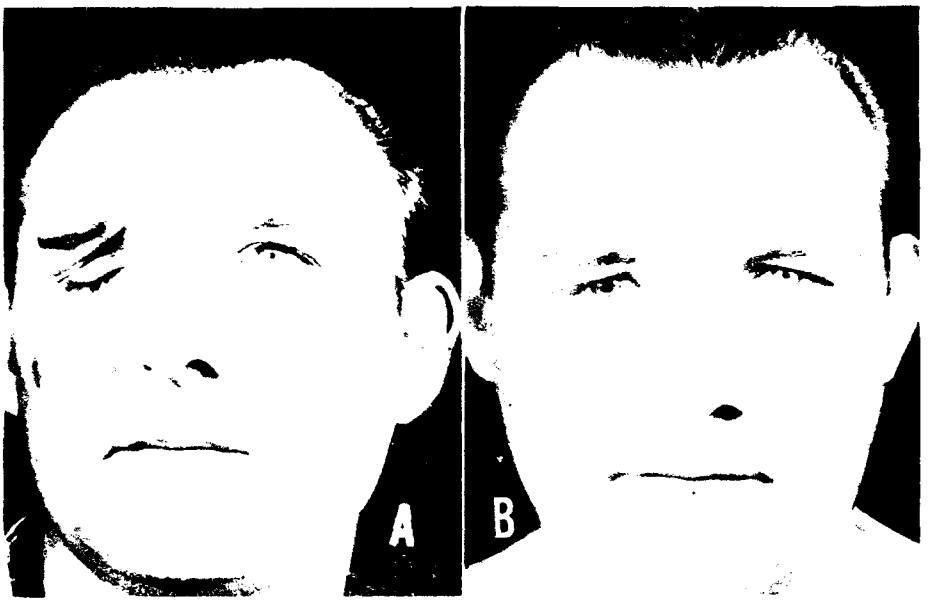


FIGURE 84. A. Broadening deformity of nasal bones with displacement to left; forward and lateral displacement of frontal process of right maxilla; branching linear scar over this area, with deformity of medial canthus; and cicatricial contracture of nasal socket, 22 October 1946. These deformities followed a compound fracture of the maxilla and nasal bones, with rupture of the right eye, in a jeep accident on 1 September 1944; the eye was enucleated, and the wounds were debrided and repaired the same day. B. Final result in August 1945, following (1) submucous resection on otolaryngologic service in December 1944; (2) refracture of nose by plastic surgeon in February 1945; and (3) excision of scar tissue, lacrimal sac, and excess bone of displaced frontal process of maxilla on ophthalmologic service in June 1945.

had been displaced forward and laterally (fig. 84). At other times, the Z-plasty type of incision and closure was useful, since it permitted a flap of skin from the nasal portion of the upper eyelid to be placed below the elevated canthus.

Surgery of the socket. - Patients who had undergone an evisceration or a simple enucleation without an implant were frequently received in the Zone of Interior. They usually presented marked retraction of the socket within the next few months because of loss of orbital fat or, in some instances, because of depressed fractures of the floor of the orbit. In a large proportion of simple enucleations, a late implant (usually a grooved glass sphere) was placed in

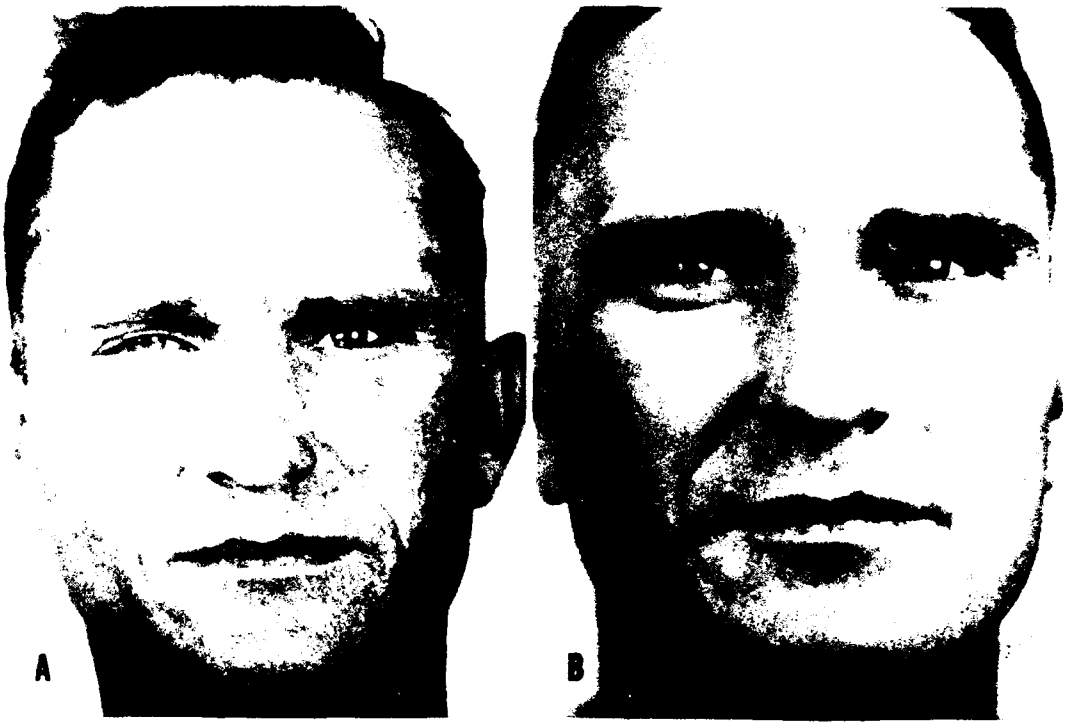


FIGURE 85.—A. Extremely retracted left socket with large acrylic eye on 25 August 1945, following accidental laceration of eye by bolt from weapons carrier, suffered 7 April 1945. The eye was enucleated 7 days later; no implant was used. B. Final result in December 1945, after implantation of grooved glass sphere in muscle cone and fitting of smaller acrylic eye on 27 November 1945.

the muscle cone (fig. 85). There was little evidence of migration of these spheres. The dermal grafts used at the Dibble General Hospital Eye Center and the bone and gold spheres used at other centers were not used at the O'Reilly eye center.

In some cases of simple enucleation, as well as in some cases of simple evisceration, there was too much retraction of the upper lid for satisfactory fitting of an ordinary glass implant. With the help of Maj. Henry E. Hahn, DC, of the acrylic eye prosthesis service at O'Reilly General Hospital, several sizes of wedge-shaped acrylic implants were provided for [illegible] on the orbital floor to elevate the depressed orbital contents. These implants were placed under the periorbita, with the large portion of the wedge posterior. The elevation of the orbital contents thus secured eliminated much of the undesirable



FIGURE 86. A. Severe penetrating wound of right frontal area and lacerated wound of eyeball from shell fragments, 27 January 1945. Evisceration was carried out the next day. Following cranioplasty and insertion of a tantalum plate on the neurologic service in July 1945, the remains of the eviscerated eye could be seen through the conjunctiva, and there was considerable retraction of the socket. B. Wedge-shaped acrylic implant which was placed under periorbita of floor of orbit 12 October 1945, to elevate and bring forward the orbital contents. C. Final result 4 weeks later after fitting of satisfactory prosthesis.

retraction of the upper lid and of the skin above it (fig. 86). In a similar procedure, developed at Dibble General Hospital for use in fractures of the floor of the orbit, a rhomboid-shaped plate of acrylic was sutured in place on the periorbita rather than under it.

Cicatricial contractures of a portion of the socket, which were rather frequent, were usually corrected by excision of underlying scar tissue and the application of a mucous-membrane graft from the inner surface of the lower lip. A form made of dental molding compound was used for 2 to 3 weeks, followed by the use of an acrylic eye prosthetic form for another 2 or 3 weeks before an eye prosthesis was made. Mucous-membrane grafts were preferable to the combination of a Thiersch graft with normal conjunctiva. This combination almost always produced a profuse, foul discharge.



FIGURE 87. A. Extremely contracted socket containing thick-wrinkled skin, 9 June 1945. This patient, in childhood, had suffered a lye burn which resulted in a blind eye and marked cicatricial contracture of the conjunctiva. After his induction into the Army, an operation for symblepharon was performed, followed by enucleation and four operations to enlarge the socket with Thiersch grafts. B. Appearance of socket after excision of skin and scar tissue and restoration by epidermal graft, 26 June 1945. C. Final result with acrylic prosthesis in situ in September 1945.

Extensive contracture of the socket resulting from battle-incurred injuries was not usual. When such cases were observed, the procedure of choice was restoration by Wheeler's epidermal graft (fig. 87).

Small depressions resulting from loss of a portion of the orbital margin were satisfactorily corrected by the use of fascia lata as a filling material (fig. 88). For more extensive losses, bone grafts from the crest of the ilium chiefly of cancellous bone, produced better results than cartilage graft (fig. 89). The



FIGURE 88. A. Loss of bone of lateral supraorbital ridge with overlying scar of brow and large and retracted socket, 6 June 1945, following compound fracture of lateral left supraorbital area and rupture of eyeball from machinegun bullet on 3 April 1945; the eye was enucleated the same day at an evacuation hospital. B. Final result in December 1945, following (1) implantation of grooved glass sphere implant to orbit and filling of defect of supraorbital ridge with fascia lata on 6 August 1945; (2) implantation of medium-sized acrylic wedge implant under periorbita of floor of orbit to elevate orbital contents 3 months later.

tantalum-mesh method, used with satisfactory results at Cirile General Hospital, was not employed at O'Reilly General Hospital. Grafts of iliac bone could be shaped satisfactorily, and they healed solidly in a few weeks. The use of a small drain for a few days seemed to eliminate the risk of a breaking down of the wound from the collection of subcutaneous blood clots.

When extensive loss of the eyelids and surrounding tissue made it impossible to reconstruct anything better than immobile, unnatural eyelids, with a staring, conspicuous artificial eye, the usual procedure was to remove the remnants of conjunctiva and cover the orbit with a continuous layer of smooth skin (fig. 59A to D, inclusive).



FIGURE 89. A. Depression of left lateral eyebrow area with upward displacement of brow, cicatricial contracture of temporal half of socket, and moderate paralytic ptosis of upper eyelid, 15 February 1945, following penetrating wound by shell fragment on 11 November 1944. The missile passed through the left frontal area, orbit, and eyeball and lodged near the angle of the mandible on the right. B. Final result in January 1946, after (1) straightening of eyebrow by Z-plasty in May 1945; (2) graft of cancellous bone from ilium to brow area in September 1945; (3) resection of tarsus and levator in October 1945; (4) excision of scar tissue from lateral socket and mucous-membrane graft to form temporal socket 6 weeks later; (5) wedge acrylic implant to floor of orbit under periorbita, 6 January 1946, and (6) fitting of prosthesis. Further improvement in appearance would be obtained by using a fascia lata graft below brow to fill out the depression.

CHAPTER XIX

Chemotherapy and Antibiotic Therapy in Zone of Interior

Phillips Thygeson, M. D.

Chemotherapy with penicillin and the sulfonamide drugs was widely used in the prophylaxis and treatment of ocular infections in World War II. This chapter, which is concerned with experiences in the Zone of Interior, is based on the personal experience of the writer and on data obtained by him from the chiefs of the eye sections at the six major eye centers located, respectively, at Dibble, Crile, Valley Forge, Northington, Cushing, and O'Reilly General Hospitals.

GENERAL CONSIDERATIONS

Agents employed.– Only a limited number of chemotherapeutic agents were employed. Sulfadiazine and sulfathiazole were the principal sulfonamides used. Sulfanilamide was used, with few exceptions, only in trachoma. Penicillin was the only antibiotic employed with any regularity, although tyrothricin was used topically to a limited extent. Streptomycin was not employed in the cases included in this report.

Methods of administration. The sulfonamide drugs were used orally and topically. Their oral use in eye infections differed in no essential way from their oral use in general infections. Topical application, however, required some adaptation to ocular conditions. Vanishing-cream bases, such as were used in preparations for the skin, were found to be too irritating for conjunctival use. In general, bland ointment bases, such as USP ointment base, petrolatum, or petrolatum-lanolin mixtures, were employed. In the treatment of corneal ulcers, sulfadiazine powder was dusted directly into the conjunctival sac, and sodium sulfadiazine was administered by iontophoresis and by corneal bath in a limited number of cases.

Penicillin was employed systemically by intramuscular injection and topically in solution or ointment form. No instances of its oral use in military ophthalmology were reported. The solutions were usually in concentrations of either 500 units or 1,000 units per cubic centimeter and the ointments in 1,000-unit concentrations. Penicillin was also employed in a few instances by iontophoresis and corneal bath, but only a single instance of the use of sodium penicillin by intraocular injection was reported from the eye centers. Com-

bined sulfonamide and penicillin therapy was occasionally employed, and fever therapy was sometimes combined with sulfonamide or penicillin therapy.

Prophylactic use of the sulfonamides and penicillin.—Penicillin by intramuscular injection and sulfathiazole or sulfadiazine by mouth were used prophylactically in certain cases of blepharitis requiring intraocular surgery. Penicillin by intramuscular injection was frequently used in extensive plastic repair of the lid and orbit, and one or another of the drugs, usually one of the sulfonamides because of their wider action, was used in most penetrating wounds of the globe. Topical application of the sulfonamides was occasionally made in an effort to prevent infection of the sound eye in such conditions as unilateral gonorrheal ophthalmia and trachoma. The sulfonamides and penicillin were used extensively, both topically and systemically, in the prophylaxis of infections from burns.

RESULTS OF CHEMOTHERAPY

The results of chemotherapy in ocular infections in Army hospitals in the Zone of Interior (table 7) appear to differ in no essential way from the chemotherapeutic results reported in the civilian literature.

Trachoma Results

In the Zone of Interior, sulfonamide therapy was consistently effective in the treatment of trachoma. Observations on 23 cases in the Army revealed no apparent difference between the results obtained with sulfanilamide and with sulfadiazine. Sulfathiazole, on the other hand, proved to be less satisfactory than the other two drugs.

Experience showed that trachoma is treated most successfully by relatively small doses of a sulfa drug, repeated over a considerable period of time, rather than by large doses administered in a short period of treatment, as used in acute systemic infections. In this respect, trachoma is comparable to lymphogranuloma venereum, a closely related virus disease which is also best treated with small doses over a long period of time.

TABLE 7.—*Response to chemotherapy in the management of ocular infections*

[Degree of response: Rapid, ++++; satisfactory, +++ and ++; and questionable, +]

Infective organism	Sulfonamides	Penicillin	Tyrothricin
Pneumococcus:			
Dacryocystitis	++++	++++	----------
Conjunctivitis	++++	++++	+++
Hypopyon keratitis	++	++	----------
Endophthalmitis	++	++	----------

TABLE 7. *Response to chemotherapy in the management of ocular infections* Continued

[Degree of response: Rapid, ++++; satisfactory, +++ and ++; and questionable, +]

Infective organism	Sulfonamides	Penicillin	Tyrothricin
Streptococcus hemolyticus:			
Impetigo	++++	++++	----
Erysipelas	++++	++++	----
Conjunctivitis	+++	++++	++
Hypopyon keratitis	+++	+++	----
Endophthalmitis	++	++	----
Dacryocystitis	++++	++++	----
Orbital cellulitis	++++	++++	----
Streptococcus viridans:			
Conjunctivitis	+	++	+
Staphylococcus aureus:			
Impetigo	++++	++++	++
Blepharitis	++	++	++
Conjunctivitis	++++	++++	++
Marginal keratitis	++	++	++
Endophthalmitis	++	++	----
Hordeolum	+	+	+
Orbital cellulitis	++	+++	----
Gonococcus:			
Conjunctivitis	++++	++++	----
Endogenous conjunctivitis	++	----	----
Uveitis	----	----	----
Meningococcus:			
Conjunctivitis	++++	++++	----
Neisseria catarrhalis:			
Conjunctivitis	++++	++++	----
Hemophilus influenzae, H. conjunctivitidis (Koch-Weeks):			
Conjunctivitis	++	----	----
Escherichia coli, Bacillus proteus:			
Conjunctivitis	++	----	----
Brucella abortus, Br. melitensis, Br. suis:			
Uveitis	----	----	----
Pseudomonas pyocyanea:			
Keratitis	++	----	----
Diplobacillus (Morax-Axenfeld):			
Conjunctivitis	++	----	----
Blepharitis	++	----	----
Syphilis:			
Uveitis	----	+++	----
Interstitial keratitis	----	----	----
Trachoma	++++	----	----
Inclusion conjunctivitis	++++	----	----

In the 23 cases just mentioned, trachoma was treated by sulfanilamide or sulfadiazine in doses sufficient to maintain an average blood level of from 3 to 5 mg. percent. This level was reached by means of an initial dose of 5 gm. daily, administered in 4 doses, the first being given immediately upon the patient's awakening and the last immediately before his retiring. It was usually possible to reduce the dose to 3 gm. daily after from 5 to 7 days. Treatment was continued until the cornea became free from infiltrates and punctate fluorescein-staining epithelial erosions. It was then discontinued, irrespective of the state of the conjunctiva, experience having shown that as long as several months may be required for the conjunctival follicles to absorb after cessation of sulfonamide therapy. The period of treatment varied from 2 to 3 weeks. Not a single sulfonamide-resistant case was encountered. In the cases in which complete relief of all inflammatory signs was not effected, the cause of the continuing inflammation was readily ascertainable; concomitant staphylococcic blepharitis was responsible in three cases and concomitant vernal catarrh in one.

Local sulfonamide therapy was employed as a supplement to general sulfonamide therapy in most instances but was probably unnecessary since, in the few cases in which it was omitted, healing appeared to be just as rapid. All six Army eye centers reported equally successful use of the sulfonamides in trachoma.

Penicillin therapy was administered in three cases without any appreciable effect on the disease, and no instances of the successful use of penicillin in trachoma in the Army were reported.

Three cases of inclusion conjunctivitis were observed in Army personnel and fourteen cases in infant dependents. In the three adults, sulfadiazine by mouth was effective in the same dosage as was used in treating trachoma but the treatment time was shorter, 7 days sufficing. In the 14 infants, 5-percent sulfathiazole ointment applied from 4 to 6 times daily over a period of 10 days was effective in every case. All eye centers reporting this disease described similarly dramatic results with the sulfonamides.

Penicillin therapy was not tried in any of the adult cases, but penicillin ointment was found to be ineffective in the infant cases. Tyrothricin ointment was also applied and found to be equally ineffective.

Three cases of gonorrheal ophthalmia responded rapidly to penicillin injected intramuscularly. Smears were negative within 24 hours, and hospitalization periods were limited to 5 days.

In certain of the eye centers, sulfathiazole and sulfadiazine were also employed with equally good results. No instance of sulfonamide-resistant or penicillin-resistant gonorrheal ophthalmia was observed, although several such cases have been reported in the literature.

A considerable number of cases of meningococcic conjunctivitis, which developed as part of the epidemic meningitis occurring in various Army installations, were diagnosed and treated by military ophthalmologists. It is

probable that in addition many mild cases without meningitis were not diagnosed but were treated successfully as nonspecific catarrhal conjunctivitis.

The writer observed and treated only three cases which were primarily ocular and showed no systemic manifestations of any kind. In one, sulfadiazine was administered orally, and 5-percent sulfathiazole ointment was applied locally. In the other two, the local application of 5-percent sulfathiazole ointment alone was made. All 3 cases, 2 of which were severe and 1 of which was mild, responded rapidly.

Similar experiences were reported from Army installations throughout the country. No instances of the use of penicillin for meningococcic ophthalmia were reported.

Sulfathiazole ointment was given an extensive trial in the treatment of acute catarrhal conjunctivitis in Army installations throughout the country. In the writer's experience, the drug proved to be superior to all ordinary antiseptic collyria or ointments. An epidemic of Koch-Weeks conjunctivitis afforded an excellent opportunity to test the drug in this disease; it was found to be almost uniformly effective. It was consistently effective also in both pneumococcic conjunctivitis and that caused by the *Bacillus influenzae* and, although less efficacious, was still superior to ordinary antiseptics in acute staphylococcic conjunctivitis. Penicillin ointment (1,000 units per gram), on the other hand, although effective in pneumococcic and staphylococcic conjunctivitis, was consistently ineffective in that caused by the Koch-Weeks bacillus and *B. influenzae*.

The majority of cases of chronic catarrhal conjunctivitis in the Army appeared to be secondary to chronic blepharitis, either seborrheic or staphylococcic. Only a few cases of diplobacillary blepharitis and conjunctivitis were noted by the writer. Chemotherapy with sulfathiazole ointment and penicillin ointment was moderately effective in staphylococcic blepharoconjunctivitis, very effective in diplobacillary blepharoconjunctivitis, but ineffective in seborrheic blepharoconjunctivitis. In the mixed seborrheic and staphylococcic type of infection, sulfathiazole and penicillin ointments, although only moderately effective, were still superior to other methods of antiseptic treatment. Both penicillin and sulfathiazole were ineffective in conjunctivitis caused by severe meibomitis, and penicillin ointment seemed to be totally ineffective in chronic conjunctivitis caused by diplobacilli or coliform bacteria. No cases of chronic conjunctivitis caused by streptococci were encountered.

In three cases of orbital cellulitis and abscess of undetermined etiology, sulfadiazine by mouth resulted in rapid relief of symptoms. In a fourth case, caused by beta hemolytic streptococci (penicillin sensitive by laboratory test), was an empyema of the frontal sinus which produced necrosis of the bone and extended into the orbit. Penicillin failed to relieve the condition, and radical surgery was necessary. Comparable results with chemotherapy in this condition were experienced in most eye centers.

In four cases, acute dacryocystitis responded rapidly to the sulfonamides when treatment was started early. In one case, a remarkable result was obtained. A pilot who had survived a plane crash sustained a fractured nose followed by obstruction of the lacrimal canal, with constant epiphora. Oral sulfadiazine therapy was started about 24 hours after the development of an acute dacryocystitis. There was rapid relief of all symptoms, including apparent permanent relief of the tearing.

The successful use of penicillin therapy in cases of acute dacryocystitis was noted in reports from three of the eye centers.

In the writer's experience, ulcerative blepharitis (staphylococcic) almost always responded well to sulfadiazine, sulfathiazole, or penicillin ointment, although permanent cures were not obtained consistently. Nonulcerative blepharitis responded less well, and cases definitely resistant to sulfathiazole, penicillin, or both were encountered.

A single case of erysipelas of the eyelids healed very rapidly with general penicillin therapy.

Corneal ulcers, usually secondary to staphylococcic blepharitis, were of common occurrence among Army personnel. They generally responded well to either sulfathiazole or penicillin ointment, although there were some recurrences. Central or serpiginous ulcers caused by pneumococci or streptococci were apparently very uncommon, but the few patients seen with the condition did well when treated with either sulfonamide or penicillin ointment. The writer preferred to treat the cases by curetting the ulcer crater to remove necrotic material and then dusting in sulfadiazine powder. Penicillin solution instilled into the eyes at frequent intervals was reported to have yielded favorable results at several of the eye centers.

Equivocal Results

It was not possible to determine the etiology in most of the cases of endophthalmitis and panophthalmitis seen in Army personnel, but the impression was gained that chemotherapy is of value in the prophylaxis and treatment of early infections. In four cases, oral sulfonamide therapy, supplemented with topical application of sulfadiazine powder or with sodium sulfadiazine by iontophoresis, was relied upon. As it is well known that the sulfonamides and penicillin do not penetrate at all well into the vitreous, injection of penicillin directly into the vitreous in cases of incipient vitreous abscess is clearly indicated. None of the six eye centers reported the use of this procedure, but one did report repeated injections into the anterior chamber in the treatment of an infection which followed trephining.

In the writer's experience, acute meibomitis, even when caused by penicillin-sensitive staphylococci, did not respond appreciably to sulfathiazole, sulfadiazine, penicillin, or tyrothricin. This is probably because of the failure of all these agents to gain entrance into the meibomian secretions in any

appreciable amount. Oral chemotherapy may have had some effect in shortening the course, but local therapy was totally ineffective.

In one case of interstitial keratitis, which was treated by a combination of penicillin and intravenous typhoid therapy, a total dose of 2,225,000 units of penicillin was administered over a 10-day period. There was no evidence in this case to indicate that the keratitis had been modified to any appreciable extent, although favorable results from penicillin therapy of interstitial keratitis had been observed at two other eye centers.

Three cases of iridocyclitis with positive tests for syphilis were treated with penicillin in large doses. One of the three patients made a dramatic recovery which seemed unquestionably to be the result of therapy, but the other two were unimproved. None of the three showed any specific granulomatous changes or any obvious physical signs of the disease.

No cases of gonorrheal uveitis were observed or reported from the eye centers, but there was good reason to believe that this condition would respond to both sulfonamide and penicillin therapy.

Failures

A large series of cases of nonspecific uveitis were treated by the sulfonamides, penicillin, and by combinations of these drugs with fever therapy. It seems quite certain that chemotherapy alone did not modify the disease. Data from all eye centers substantiated this point.

In four cases of sympathetic ophthalmia, neither sulfonamide nor penicillin therapy modified the course of the disease in any way.

Three cases of ocular pemphigus were treated first with sulfadiazine and subsequently with penicillin without modification of the disease.

Five cases of nonsyphilitic optic neuritis were treated with sulfadiazine and later with penicillin without appreciable result. There was general agreement in the data from the eye centers that this condition was not amenable to chemotherapy.

Several of the eye centers reported failure to influence herpetic keratitis by chemotherapy, which was to have been expected in view of the virus etiology of the disease. The writer tried intravenous sodium iodide, as advocated by Allen, but obtained no result.

COMPLICATIONS OF THERAPY

Reactions to penicillin.—The commonest complication of penicillin therapy was the development of skin sensitivity and resultant contact dermatitis. This was noted with significant frequency following topical use of the drug. Complications following intramuscular administration were limited to an occasional urticarial eruption.

Reactions of the sulfonamides.—Contact dermatitis was an occasional complication of local sulfonamide therapy. In the Army, 5-percent sulfathiazole ointment was a standard preparation, and as a result most sensitivities were to sulfathiazole rather than to sulfadiazine. Fortunately, they were not sufficiently frequent to warrant limiting the use of the drug. There were almost no cross sensitivities to the sulfonamides. Complications following their oral use were insignificant when the usual precautions concerning alkalinization, blood studies, dosage, and other matters had been taken. No major complications were reported from the eye centers.

SUMMARY

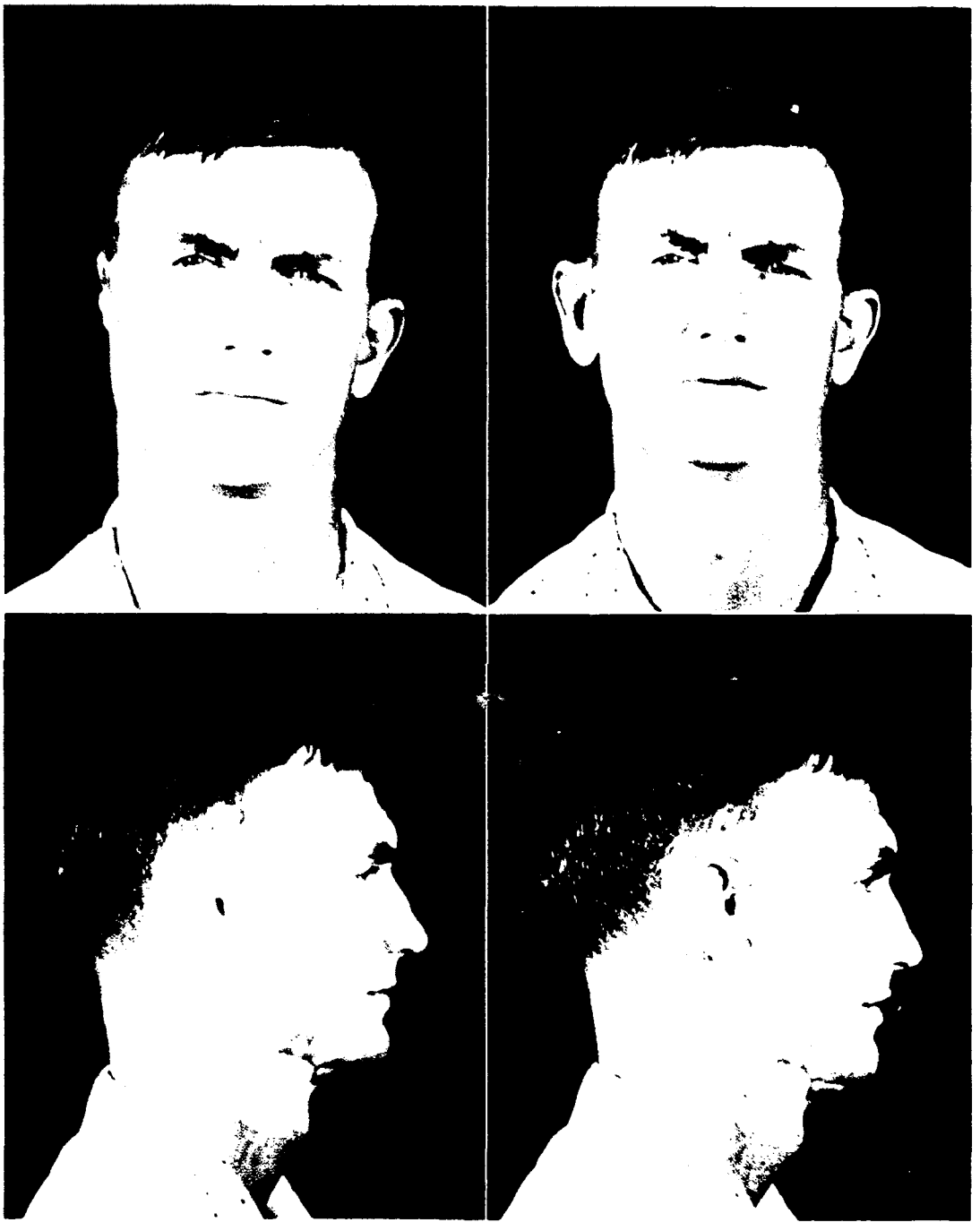
Chemotherapy and antibiotic therapy were used extensively in the eye centers of the Zone of Interior in the prophylaxis and treatment of ocular infections. Sulfathiazole, sulfadiazine, and penicillin were employed predominantly and sulfanilamide and tyrothricin occasionally. For prophylactic purposes, chemotherapy was used effectively in penetrating wounds of the globe and orbit and in emergency surgery in the presence of conjunctivitis or blepharitis. For therapeutic purposes, topical applications of sulfathiazole ointment and penicillin ointment were used extensively in local staphylococcic infections, particularly staphylococcic blepharitis, and in acute conjunctivitis. Sulfathiazole and sulfadiazine were administered orally in the treatment of trachoma, acute dacryocystitis, gonorrheal ophthalmia, meningococcic ophthalmia, orbital cellulitis, corneal ulceration, and intraocular infections. Penicillin proved ineffective in trachoma but was particularly useful in infections caused by staphylococci, streptococci, and gonococci. A limited number of trials of these agents in corneal ulceration and intraocular infections by iontophoresis and by corneal baths were only partially successful. Attempts were made to supplement the chemotherapeutic properties of individual drugs by combining them, for example, sulfadiazine with penicillin, or by combining fever therapy with penicillin or sulfadiazine.

In general, the results obtained in the use of chemotherapy in ocular infections in the military eye centers did not differ essentially from those reported from civilian clinics and hospitals.

Part II

OTOLARYNGOLOGY

Norton Canfield, M. D., Editor



Nasal surgery after trauma.

CHAPTER I

Administrative Aspects of Otolaryngology

Norton Canfield, M. D.

HISTORICAL NOTE [1]

Otolaryngology in the Continental United States

In World War I, a section of otolaryngology was organized in the Surgeon General's Office 7 August 1917, shortly after the appointment of a consultant in surgery. A subcommittee on otolaryngology had been functioning as part of a committee on surgery in the Council of National Defense, which had been created 3 June 1916, and the first activity of the newly created section was to continue the work begun by this subcommittee.

The chief activity of the subcommittee had been threefold: (1) The collection of data, by means of questionnaires, concerning otolaryngologists available for military service; (2) the distribution of application blanks for the Medical Reserve Corps of the Army; and (3) the classification of applicants for commissions when the application blanks were returned to the Surgeon General's Office. As the result of these measures, a list had been prepared of otolaryngologists throughout the country who were available for immediate or deferred military service. Classification and rating, as in other specialties, were on the basis of data supplied by the applicants themselves.[2] When the data were unavailable or insufficient or for any reason were questionable, the rating was clarified by conferences with members of the profession who had been selected to serve as consultants in the various States.

The chief function of the Section of Otolaryngology in the Surgeon General's Office was the selection of adequate personnel and its placement in the best interests of the military service, with consideration, as far as possible, of the desires of the individual specialists. Otolaryngologists were assigned to camp and base hospitals in the United States from among the physicians who had indicated on their questionnaires a willingness to serve, and at the same time a tentative list of assignments for base hospitals overseas was drawn up.

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[1] The Medical Department of the United States Army in the World War. Washington: Government Printing Office, 1923, vol. I, pp. 453–456, and 1924, vol. XI, pt. 2, secs. V and VI.

[2] The late Dr. Harris P. Mosher (1867–1954), then in the military service on duty in the Section of Otolaryngology, noted, in many instances, certain inadequacies in training and qualifications. This was a revealing experience for him and one which had tremendous effects upon the specialty. The resulting development of modern otolaryngology, with high standards of teaching, largely may be attributed to his dynamic leadership. [Editor's note.]

The Section of Otolaryngology, with the Section of Ophthalmology, designed a type of building to be used in the United States for these specialties and for the specialties of brain surgery and maxillofacial surgery. A similar building was later designed for use in hospitals overseas. A working set of otolaryngologic instruments was prepared and distributed to base hospitals. The original list later was modified, extended, and standardized. A list of instruments for the use of the special overseas hospital just mentioned was also prepared.

Other activities of the Section of Otolaryngology included revisions of standards of hearing for admission to the Army; amplification of tests for malingering; revision and rearrangement of regulations for medical advisory boards as they concerned otolaryngology; investigation of ear protectors, for which purpose a special committee was appointed; inauguration of a program for rehabilitation of deafened casualties; preparation of a manual of abstracts on otolaryngology during the war, published in 1918 as Medical War Manual No. 8; publication of a monthly journal; and preparation and distribution (15 August 1918) of a form for monthly reports of otolaryngologic operations in general, base, and post hospitals. These monthly reports later became part of the permanent records of the Surgeon General's Office.

The School of Otolaryngology of the Medical Officers' Training Camp at Camp Greenleaf, Fort Oglethorpe, Ga., was activated 8 May 1918, with a student enrollment of 19 medical officers. It was closed in January 1919, after 90 student officers had attended, 57 of whom were rated as qualified otolaryngologists upon the conclusion of their studies. The school was fully supplied with instruments and other necessary equipment for teaching, including a collection of anatomic specimens supplied by individual officers specializing in otolaryngology. By arrangement with the commanding officer of the Medical Officers' Training Camp, students in the school who had completed 6 weeks of military training were allowed to give their entire time to professional work. The course of instruction in the school of otolaryngology was arranged on a 4-week basis.

An otolaryngologic service was established at each general and base hospital in the United States under the direction of a chief who had had extensive civilian experience in this specialty. Younger, less experienced specialists served as his assistants. Special ward and clinic space was assigned to otolaryngology in all installations, and in some hospitals special operating rooms were also designated for the specialty. Until the Army could supply the necessary instruments in adequate numbers, individual officers frequently used their personal equipment.

The chief of the Section of Otolaryngology inspected various hospitals in the United States in October 1917 and in June and July 1918. In late October 1917, he was a member of a party which made a 2 month's tour of observation overseas. The chief mission of this group was to make observations on surgical specialties relating to the head and on the medical care of aviators. They

were given ample opportunities to observe how these specialties were managed in the English and French Army hospitals. The group also visited the majority of the American base hospitals in France. At the conclusion of this mission, an extensive report, with recommendations, was made to The Surgeon General by the chief of the Section of Otolaryngology.

After the armistice was signed, the activities of the Section of Otolaryngology were concerned chiefly with the release, retention, or reassignment of its specialized personnel. The staffs of nonspecialized hospitals were reduced to a minimum, but the staffs of specialized hospitals designated to receive head cases were increased and strengthened. The Section of Otolaryngology also collected and tabulated historical data derived from replies to circular letters sent to all general, base, and post hospitals, in addition to material already in the Surgeon General's Office.

A total of 736 otolaryngologists, including officers who had been trained in that specialty in the course of the war, served in the United States Army during World War I. As of 23 November 1918, 165 were serving overseas (120 of whom were assigned to base hospitals) and 115 were under orders for overseas. Two hundred and forty-four were in service or under orders in the United States (159 of them in cantonments and base hospitals). Two hundred and eight had been released from the Army, and four had died in service.

Otolaryngology in the American Expeditionary Forces

A consultant in otolaryngology to the line of communications was appointed in the Surgeon General's Office 30 August 1917. This same officer was appointed 1 April 1918 as senior consultant and director of ear, nose, and throat surgery in the American Expeditionary Forces. At this time, he assumed supervision of all otorhinolaryngologic personnel in the Medical Corps overseas and also assumed the responsibility for the overall management of patients requiring otolaryngologic care.

As the American Expeditionary Forces increased in numbers, the senior consultant found himself unable to supervise the otolaryngologic services in the hospitals in Europe without assistance, and several experienced otolaryngologists were appointed as consultants to him. Consultants in otolaryngology were also assigned to armies and corps and to the various hospital centers.

Services in overseas base and evacuation hospitals were organized as in similar institutions in the United States, under the direction of an experienced chief of service, with such assistants as the needs of the special services dictated. The allotment of facilities was also much the same as in the United States.

Otolaryngologists were usually sent overseas attached to hospitals. On 12 September 1918, however, six were sent over in a unit, but unattached, to be available for quick assignment as they were needed. A second similar unit was put under orders 21 November 1918.

The first otolaryngologists sent overseas during World War I were part of the complements of the first base hospitals to arrive in France. For some time, these officers were able to supply the necessary otolaryngologic care for all United States Army military personnel in France. Later, as additional troops arrived, a shortage of these specialists became evident. Although the bed capacity of many hospitals had been greatly increased, the otolaryngologic service continued to be conducted for some time by a single officer, who frequently had the added responsibility of providing ophthalmologic care. Eventually, additional officers were added to these services, as just noted.

Before United States troops were actively engaged in combat, diseases requiring otolaryngologic care were much the same as those encountered in civilian life, and each hospital operated a large dispensary service. When fighting became more intense, many patients with otolaryngologic conditions which did not warrant hospitalization were evacuated to base hospitals from the forward areas, with a corresponding loss in manpower. The assignment of otolaryngologists to the divisions remedied this situation.

This matter was reported to the Chief Surgeon, American Expeditionary Forces, by the senior consultant in otolaryngology in a letter dated 15 July 1918, in which he made particular mention of one convoy in which 58 or 60 patients sent back from the lines for supposed otolaryngologic conditions actually required no treatment at all.

In another letter, dated 15 July 1918, the senior consultant recommended that otolaryngologists in mobile and evacuation hospitals should be assigned to one of the permanent surgical teams. They would perform the duties of surgical assistants when they were not occupied with their own special duties, for which, in this assignment, they would be immediately available. These instructions were circulated to the commanding officers of evacuation and mobile hospitals by the headquarters of the medical and surgical consultants.

In base and camp hospitals, improvements in the otolaryngologic services were effected by the systematic instruction of all officers in those services in functional examination of the vestibular apparatus, with special emphasis on uniformity of methods of examination and of classification for return to duty. In addition, the senior consultant, at the suggestion of the director of Professional Services, American Expeditionary Forces, prepared a circular which outlined the routine treatment considered advisable for the lesions of the ear, nose, and throat most frequently encountered.

A special head hospital (Base Hospital No. 115) arrived in France 2 September 1918 and immediately began to function at Vichy. Instructions for the disposition of various categories of otolaryngologic patients were issued 4 October 1918, and it was directed that those who required prolonged or special treatment should be sent to this installation. Base Hospital No. 115 also served as a center of instruction for officers who needed practical train-

ing in the reconstructive surgery of battle casualties or who required instruction in methods of routine functional aural testing.

Otolaryngology Between the World Wars

In the interval between the First and Second World Wars, civilian specialists, regardless of their specialties, had little opportunity to observe or influence specialty practice in the Army and did little or nothing to create such opportunities for themselves. Medical officers in the Regular Army, for their part, had only limited opportunities to progress in the practice of any specialty. Civilian specialists were usually consulted for patients who required specialized care, and specialization in the Medical Corps was not particularly encouraged. Kubie's study,[3] published in 1944 but carried out 2 years earlier, showed that, in 1939, only 21 of the 77 officers in the Regular Army Medical Corps who were certified by the various specialty boards had been certified by the American Board of Otolaryngology.

ADMINISTRATIVE POLICIES IN OTOLARYNGOLOGY IN WORLD WAR II

In World War II, in contrast to the early development of a section on otolaryngology in World War I, an otolaryngologic branch was not established in the Surgeon General's Office until July 1944. The impetus for the creation of the branch at this time was the reorganization of the Aural-Rehabilitation Program for the Deafened and Hard of Hearing (p. 447). Until the end of the war, the activities of the consultant in otolaryngology, Maj. (later Lt. Col.) Leslie E. Morrissett, MC, were limited almost entirely to that program, his responsibilities for otolaryngology in general being incidental to his duties in connection with the Aural-Rehabilitation Program. Three civilian consultants in otolaryngology (Dr. Albert C. Furstenberg, Ann Arbor, Mich.; Dr. Dean McAllister Lierle, Iowa City, Iowa; and Dr. John Mackenzie Brown, Los Angeles, Calif.) had been appointed early in the war. Their function was entirely advisory.

A consultant in otolaryngology began to function in the European Theater of Operations in August 1942, a month after the Professional Service Division was set up in that theater. In no other theater of operations, however, was a consultant in this specialty appointed, and uniform administrative and clinical policies can therefore be reported only from that theater.[4]

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[3] Kubie, L. S.: The Problem of Specialization in the Medical Services of the Regular Army and Navy Prior to the Present Emergency. Bull. New York Acad. Med. 20: 495-511, September 1944.

[4] Unless otherwise stated, the subsequent sections in this chapter are based on the annual reports, with accompanying exhibits, of the senior consultant in otolaryngology, European Theater of Operations, and on reports submitted to him, on his instructions, after D-day by otolaryngologists in charge of the services in that specialty in the hospitals in the European theater.

THE CONSULTANT SYSTEM IN THE EUROPEAN THEATER OF OPERATIONS

To meet the otolaryngologic needs in the European Theater of Operations temporarily, until a permanent consultant could be appointed, Maj. Edmund P. Fowler, Jr., MC, served as acting consultant in otolaryngology from August 1942 until January 1943, when Lt. Col. (later Col.) Norton Canfield, MC, was ordered to the theater as senior consultant in otolaryngology.

Functions of the Senior Consultant in Otolaryngology

The senior consultant in otolaryngology consulted with the Chief Surgeon of the theater and the chief surgical consultant on all matters of professional policy in the field of otolaryngology, as well as on all phases of personnel, hospital management, equipment, and supplies. He was responsible for the preparation of professional directives concerning the medical and surgical care of otolaryngologic casualties, and, as the war progressed, he recommended changes in professional policy which were implemented by the Chief Surgeon.

For the most part, however, Colonel Canfield's chief means of carrying out his duties was by consultation with the otolaryngologic officers assigned to hospitals. Only one tour of hospitals on the Continent was made, immediately after D-day, but most hospitals in the United Kingdom were visited at various intervals. During these visits, surveys were carried out and discussions initiated concerning theater policies, equipment, supplies, personnel, and professional care. Serious and difficult cases were examined personally. An adequate number of the more routine cases were observed to ascertain that the treatment rendered was of a superior quality. Decisions on professional policy were made within the regulations and limitations fixed by the War Department and the theater commander, as well as in accordance with local conditions of troop concentrations, proximity to other hospitals, and the status of combat. Recommendations for transfer of patients were always interpreted in the light of these considerations.

Regional Consultants

The system of regional consultants in otolaryngology which was developed in the European Theater of Operations was the natural outgrowth of the shortages of specialist personnel in this field. As hospitals were concentrated in the United Kingdom before D-day, it was soon obvious that many of them were not self-sufficient in respect to otolaryngology and other specialties and that the solution of the problem was the establishment of hospital centers, with regional consultants in the various specialties assigned to each center. Since tables of organization made no provision for regional consultants, officers appointed to these positions continued to serve as chiefs of service in the hospitals to which

they were attached, their consultant duties being carried out in addition to their regular duties.

Seven centers were established in the United Kingdom before D-day. Each was composed of 12 to 22 hospitals, and each had its own commanding officer. Once the centers were formally in operation, the paper system of regional consultants became a practical means of providing specialized care. When base sections were established as the theater expanded, although no actual increase of the Professional Services Division was permitted, regional consultants in medicine and surgery were appointed, and regional otolaryngologic consultants functioned through them.

The regional consultants proved extremely useful. In addition to their own work as chiefs of section in general hospitals, they reported regularly to the senior consultant concerning the quality of professional care supplied, the need for additional equipment and instruments, the operation of the supply service, and similar matters. They also recommended changes of personnel, and they personally assumed the responsibility for the care of difficult cases.

The group system of hospitals was introduced on the Continent as soon after D-day as military exigencies permitted, and regional consultants in otolaryngology were appointed. It was necessary to depend upon these consultants rather heavily, since the expansion of medical facilities to keep pace with military operations made frequent personal contacts by the senior consultant in otolaryngology almost physically impossible.

Because of such military considerations as the rapid advance of combat troops, the forward movement of hospitals, and the evacuation of casualties to the rear, the regional-consultant system did not function as effectively on the Continent as it did in the United Kingdom. Within these limitations, however, the system was most effective. In the weeks after D-day, regional consultants in the Alsace, Normandy, Oise, and Seine Base Sections assisted in the triage of patients, the examination and treatment of difficult cases, and shifts of professional personnel. As the war progressed, the operation of the system became more and more effective, and the outstanding work of many hospital groups furnished the fullest justification for the policy of bringing the patient in need of specialized otolaryngologic care to a specialized center in which he could be treated by a competent specialist.

ASSIGNMENT AND UTILIZATION OF OTOLARYNGOLOGIC PERSONNEL

Otolaryngologic Personnel in the European Theater of Operations

One of the first duties of the senior consultant in otolaryngology in the European Theater of Operations, a study of the assignment of personnel in relation to the needs of a position and the ability and experience of the physician assigned to fill it, was also a continuing task throughout his mission.

Initial assignments were made on the basis of an officer's specialist rating[5] which had been given by the Surgeon General's Office after an evaluation of the individual's training and experience.

Although every effort was made to assign officers to duty commensurate with their rank and professional qualifications, this was not always possible. Clinical ability alone did not always qualify an officer for the assumption of responsibilities under military circumstances. At times, these and other considerations necessitated the assignment of a highly qualified otolaryngologist to a position of lesser professional responsibility. Finally, personality difficulties sometimes dictated changes in assignments which theoretically had seemed entirely appropriate.

Tables of organization for hospitals sent to the European Theater of Operations provided for one otolaryngologic officer in class A, none in class B, 401 in class C, and 53 in class D. Otolaryngologic personnel in the theater in the 3 months before 30 June 1945 actually consisted of 6 officers in class A, 54 in class B, 186 in class C, and 119 in class D. The theater was clearly oversupplied with personnel in the A and B groups, and, to meet the requirements of the tables of organization, specialists with the higher ratings were obliged to serve in posts designed for officers with lower ratings.

A number of physicians who specialize in otolaryngology also specialize in, or have considerable knowledge of, ophthalmology. This dual ability was reflected in the MOS classification of the specialists in the European Theater of Operations. The same classification number was used if their ability in both specialities was equal, but different letters were used if they were more competent in one specialty or the other. Individual assignment of otolaryngologists and of otolaryngologists with training and experience in ophthalmology was possible in 17 different categories in the European Theater of Operations.

In all, exclusive of officers performing administrative duties (who left specialty practice as their Army rank increased) and of officers of the Army Air Forces, 364 medical officers who had sufficient training to qualify them for specialty rating in otolaryngology reached the European theater. One hundred and eighteen of these were certified by the American Board of Otolaryngology. Of 343 officers classified by the Surgeon General's Office as specializing in both otolaryngology and ophthalmology, 17 were certified by the American Board of Otolaryngology and 3 were also certified by the American Board of Ophthalmology.

Assignment of otolaryngologic personnel.—As a rule, otolaryngologic officers sent to the European theater in general hospitals were capable specialists, well qualified to form the nucleus of specialist groups. Four of the first six general hospitals which arrived in the United Kingdom had two otolaryngologists on their staffs, one of whom was surplus until the patient load began

[5] The classification symbol for otolaryngologists was MOS 3126 with the letters "A," "B," "C," and "D" indicating the degree of professional proficiency.

to increase with the arrival of additional troops in the theater. In the meantime, the surplus officer was frequently placed on detached duty elsewhere or was sent to another installation for temporary service.

When the tables of organization, as revised in July 1943, began to be reflected in the assignment of personnel to hospitals, general hospitals arrived in the United Kingdom with only one otolaryngologist on their staffs. As the number of troops in the theater steadily increased, it became impossible for a single officer to handle the otolaryngologic patient load of a general hospital, and an additional officer, without special training, was usually assigned to the section as assistant, either permanently or by a system of rotation. Under this arrangement, three officers whose training in otolaryngology had been interrupted by the war were able to complete their training and were later qualified to assume specialized duties in other hospitals.

Station hospitals, in contrast to general hospitals, were not uniformly supplied with competent specialized personnel. The tables of organization for a station hospital provided only a single officer to care for both otolaryngology and ophthalmology, and the officers assigned, while they were usually competent in one specialty, were seldom qualified to handle the other specialty. This situation gave rise to numerous difficulties. The transfer to general hospitals of patients needing specialized care seemed, on the surface, to solve the problem, but actually it did not. For one thing, it was a waste of military manpower to transfer patients who needed only minor procedures. For another, in serious conditions the problem was not only one of therapy but, even more important, one of diagnosis; the future management and actual outcome in many cases depended, as it always does, upon prompt diagnostic decisions. The system of regional consultants proved very useful in many such cases, and the senior consultant was also frequently available for prompt consultation. If the difficulty could not be solved in either of these ways, all patients who required specialized otolaryngologic care were promptly transferred to general hospitals.

As of 31 December 1943, 1 station hospital of 750 beds, 1 station hospital of 250 beds, and 2 installations acting as general hospitals and staffed by detached officers from general hospitals in the United Kingdom did not have the services of otolaryngologists. In three other station hospitals, well-trained ophthalmologists were in charge of the combined sections of otolaryngology and ophthalmology, but their training in otolaryngology was only what they had received in medical school.

In the 14 months preceding V–E Day, approximately 30 general hospitals of 1,000 beds each arrived in the European Theater of Operations without well-trained otolaryngologists. During this period, it was extremely difficult to supply competent specialized personnel to these and other hospitals for a number of reasons, as follows:

1. The number of specialists available, without regard to where they were assigned, did not equal the number of MOS 3126 (the otolaryngology specialty

rating) positions that were specified by the tables of organization for the units in the theater. After D-day, although the total otolaryngologic load did not rise in proportion to the increased number of patients (chiefly battle casualties) in hospital, the number of hospitals to be staffed with specialists increased faster than the number of specialists who became available, with the result that many hospitals had to be sent to the Continent without otolaryngologic personnel.

2. Attrition of specialists overseas was not compensated for by replacements from the Zone of Interior. During 1944, three otolaryngologic officers had to be returned to the Zone of Interior because of illness; a fourth was killed in an airplane crash; and, at the end of the year, two others were ready for return to the United States for physical reasons.

3. No replacements were available in the theater. Ten station hospitals had originally had both otolaryngologists and ophthalmologists on their staffs, but, by the end of 1944, nine of these had been depleted of either one officer or the other to supply incoming hospitals which had no specialists in either field on their staffs. In a few instances, highly trained specialists who were originally assigned to station hospitals were transferred to general hospitals, in which their services could be more efficiently utilized. They were replaced in the station hospitals by men of less experience or, occasionally, of no experience. Attempts to induce specialists drawing flight pay to transfer from the Army Air Forces to ground combat or service units were, quite naturally, seldom successful.

4. Because of considerations of military rank, which always hampered the operations of the specialty of otolaryngology, movement of officers from one unit to another was slow, and, even when a recommendation for transfer had been approved, weeks frequently passed before it was implemented. In this same connection, the difference between administrative policies in the Mediterranean and European Theaters of Operations made utilization of personnel from the former theater who arrived in the European theater after the fall of Rome considerably slower than was desirable.

5. After D-day, in spite of the urgent need for specialized professional care at certain locations, some commanders and some army surgeons were most reluctant to release specialists from their particular organizations, even for temporary duty elsewhere. In tactical units, in which competent medical officers were urgently needed, this reluctance was understandable, particularly in view of the length of time required to obtain medical officer, general duty, replacements for these losses. Administrative objections to the removal of specialists from hospitals with heavy specialized loads were also frequently entirely justified, regardless of the needs of other hospitals.

Not a great many changes in personnel were recommended in general hospitals until the staging period began, some 12 weeks before D-day. Then otolaryngologists were frequently ordered on tours of temporary duty, sometimes for service in the specialty and sometimes to serve on dispensary teams

in the staging area, on general surgical teams, or in special cadres as general medical officers.

Otolaryngologists were always assigned to neurosurgical and maxillofacial centers. They were seldom assigned to evacuation or field hospitals, but, if they were, they were usually attached to maxillofacial teams, so that their abilities could be most fully utilized.

Professional utilization. Approximately 95 percent of the Medical Corps officers trained in otolaryngology were so assigned in the European theater and elsewhere that their principal duties had to do with otolaryngology. Their assignments varied from service in induction centers in the Zone of Interior to service in field hospitals overseas. Within this range, their duties varied. Whether or not an otolaryngologist was utilized to the fullest extent of his specialized ability depended, in general, upon special military circumstances, including his rank, the nature of his assignment, and his commanding officer's appreciation of the importance of precise specialization.

In ideal circumstances in overseas hospitals, the otolaryngologist, upon direct orders of the commanding officer, devoted himself entirely to this specialty. In other instances, depending chiefly upon combat necessities, after his own special work had been completed he assisted in general surgical procedures, such as debridement and the application of casts and in tedious neurosurgical procedures. Under less favorable circumstances, his own special work was halted while he served as a general surgical assistant or as a surgical ward officer.

Redeployment. Redeployment following V–E Day introduced further problems growing out of the shortage of otolaryngologists in the European theater, which was derived, in turn, from shortages in the Zone of Interior. The problem was additionally complicated by the necessity of effecting redeployment in accordance with specifications of tables of organization and in relation to the individual officer's physical profile, length of service, and personal problems. Still another and by no means a small consideration was the continuing needs of troops in the European Theater of Operations during the period of readjustment. Troops on duty and those being staged for redeployment chiefly required outpatient care, a large part of which was carried out in ophthalmologic and otolaryngologic outpatient dispensaries.

The medical units to be redeployed required, according to tables of organization, 496 ophthalmologic and otolaryngologic officers, of whom 257 with MOS designation and rank appropriate to fill the assignments were available in the European Theater of Operations. To fill the remaining 239 positions, there were available in the theater only 140 other officers, of whom 15, on the basis of either grade or MOS rating, were completely unqualified for the positions to be filled. Had the war continued, there would have been 114 vacancies in the specialties of otolaryngology and ophthalmology merely for the hospitals designated for redeployment, and no officers in either specialty would have been left to care for demobilization and Reserve units. The background of the

deficit was that although tables of organization for the European Theater of Operations called for 656 officers in the two specialties, actually the theater was short 399 officers for the grades and MOS numbers required by these tables, and the shortage was aggravated when redeployment needs arose.

HOSPITAL ORGANIZATION AND ADMINISTRATION

The tables of organization for medical installations in the communications zone provided that the sections of otolaryngology and ophthalmology should be set up as a joint section under the section of general surgery, with either an otolaryngologist or an ophthalmologist in charge. The desirability of reducing the number of major sections in a hospital was the rationale of the plan. In most instances, the arrangement worked very well, though, as a rule, successful operation was the result of good personal relationships rather than basically sound organization, just as friction and inefficiency were frequently the result of incompatibility of personalities.

As a general rule, only patients with diseases and injuries of the eyes or the ear, nose, or throat were treated on otolaryngologic-ophthalmologic wards. There were, however, some exceptions to this policy. In a number of hospitals, dental patients were also treated on these wards. In some installations, when the operative load was heavy, patients with acute tonsillitis and upper respiratory infections were treated on the medical wards, to minimize the risk of infections on active surgical wards. In several installations, when large numbers of wounded were being received, a general surgical officer was on constant assignment to the otolaryngologic service and was responsible for the supervision of associated injuries.

Personnel. Experience soon proved that it was almost impossible for a single otolaryngologist to handle the outpatient service of a general or station hospital in addition to the ward service, operative work, consultations, and required administrative work. When two otolaryngologists were assigned, the junior was required to handle the paper work for the dental service. In a number of hospitals, members of the Medical Administrative Corps later relieved specialists of a large amount of the detail which formerly occupied much of their time. Prisoners of war were also useful in this capacity, and late in the war otolaryngologists were relieved of some routine work by the assignment of prisoner-of-war medical officers to treat prisoner personnel.

Nursing care was generally excellent. In many hospitals, however, the theoretically desirable practice of rotation of nurses, including rotation on night duty, did not work to the best advantage of the otolaryngologic service. This was particularly true in the outpatient dispensaries and operating rooms. Under the best circumstances, a minimum of 4 to 6 months is required before an inexperienced nurse, however capable, becomes thoroughly familiar with instruments and equipment, special treatments and dressings, and operating-

room techniques, including assistance at the operating table. Rotation of ward nurses introduced fewer difficulties.

Medical Department technicians, under the direction of ward nurses, on the whole provided uniformly good care for otolaryngologic patients. The same difficulties, however, were encountered concerning them as concerning nurses; there was failure to appreciate that it is essential to have permanent personnel for the most competent functioning of a highly specialized branch of surgery. While hospitals were operating only in the United Kingdom, enlisted aidmen were undergoing training in general military matters at the same time that they were carrying out their medical duties. Refresher basic-training programs were also frequently instituted. As a result, the otolaryngologic service was frequently and seriously disrupted. Casual enlisted substitutes, however willingly they worked, proved entirely unsatisfactory.

Consultations.— Policies varied in respect to the mechanism for handling consultations, as well as in respect to the conditions for which they were requested. They were handled in three ways:

1. Through channels, except in emergencies.— In some installations, only consultations in hospital were handled in this manner, consultations in the clinic being handled directly.

2. At specified periods each day.—The hours specified for consultation by the otolaryngologic service were made known to all ward officers and nurses, and ambulatory patients were then sent to the clinic for consultation and treatment. Other consultations were handled through channels.

3. By direct reference from the requesting officer to the otolaryngologist.— It was the general opinion that much time and paperwork would have been saved if this method had been universally applied, since the number of consultations in most hospitals was very large. The 137th General Hospital, for instance, averaged 15 consultations daily in the United Kingdom for many months, the majority for traumatic perforations of the tympanic membranes, traumatic deafness, and complaints referable to the sinuses. The 111th General Hospital had 1,663 otolaryngologic consultations in 11 months; and the 216th General Hospital, which functioned as a station hospital for 14 months, averaged 400 otolaryngologic consultations per month during most of this period.

Cooperation between the services was usually excellent in all installations. As a rule, consultations were frequent and fruitful between the otolaryngologist and the maxillofacial surgeon and neurosurgeon. In some hospitals, the otolaryngologic service secured particularly good results by the establishment of a close liaison with the radiologic service. The radiologist was furnished with a brief history of all patients referred for examination, and the films were reviewed with him. At one installation, all patients with upper respiratory infections were referred to the radiologist for a check of the paranasal sinuses. This was believed to be of much benefit in the

evaluation and treatment of any infection in these cavities. At another hospital, so many patients referred to the otolaryngologic clinic for complaints referable to the ears and sinuses were found to have dental foci of infection or impactions that the practice developed of having all otolaryngologic patients examined by the dental service. The results were frequently gratifying.

Records.—In every hospital, the quality of the records depended chiefly upon the conscientiousness of the individual ward officer and the quality of administration. Numerous changes, all of a minor character, would have made the otolaryngologic records more adequate, simpler to use, and of greater permanent value; on the whole, however, the forms were satisfactory.

Completeness of military medical records was a matter of great importance in view of the fact that, in military surgery, treatment is necessarily administered in stages, at different places, and by different personnel. The effectiveness, and sometimes the actual outcome, of subsequent treatment may depend upon an exact knowledge of previous treatment. The comment was frequently made that procedures about the face, the exact nature of which often could not be determined by later examination, were not accurately described. Another frequent comment was that operative notes on wounds of the antrum sometimes failed to state whether or not a pack had been used. In the absence of specific information on this point, further traumatic procedures were often required to determine whether or not it had been.

FACILITIES [6]

Assignment of space.—Facilities for otolaryngologic work in both the United Kingdom and on the Continent depended upon the function of the hospital and upon the basic construction of the building used; that is, whether it was a fixed civilian structure temporarily converted to hospital use or a quonset or nissen hut (fig. 1). An evacuation hospital, or any other installation which moved frequently, necessarily worked under what amounted to field conditions (fig. 2). In this type of installation, therefore, provision was made only for sufficient space for a chair, hanging light, table for medicaments and instruments for dispensary purposes, operating table with adequate lighting, and tables for instruments and linens.

In nissen and quonset huts, the space provided for the otolaryngologic and ophthalmologic clinics was usually adequate and could be adapted by individual ingenuity according to special needs. As a rule, a common waiting room was used for both otolaryngologic and ophthalmologic patients. At some installations, in which the waiting room also served as a treatment room, blackout curtains were used to provide a darkroom for transillumina-

[6] In the strict military sense, the term facilities has rather far-reaching implications. It includes such physical considerations as building and shelter of all types, as well as equipment, both generalized and specialized, and even money. It also includes all personnel required to staff the facilities. As a matter of convenience, personnel is discussed under a separate heading in this volume.

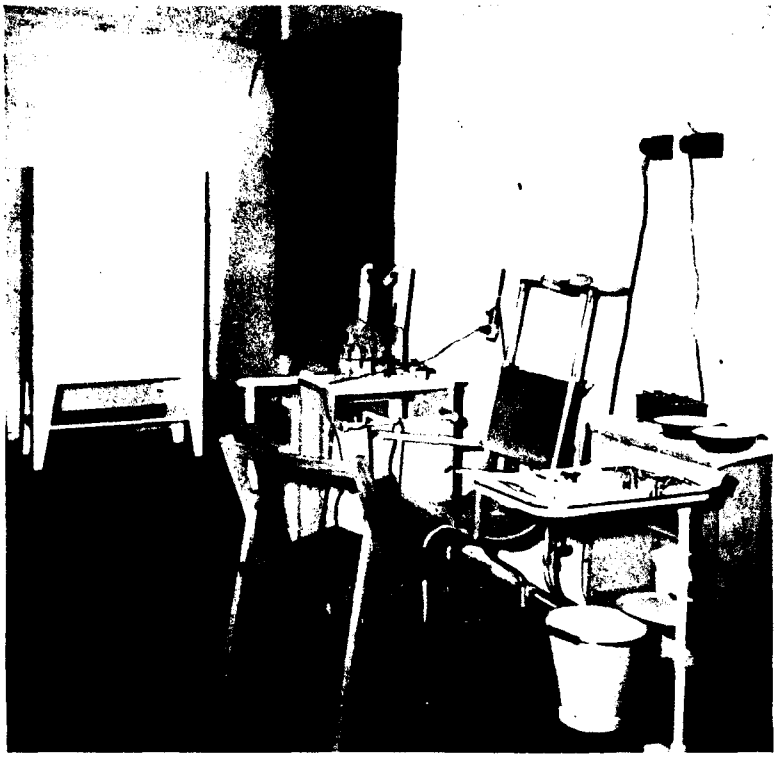


FIGURE 1.—Eye, ear, nose, and throat clinic of the 348th Station Hospital.



FIGURE 2.—The ear, nose, and throat clinic setup in a tent.

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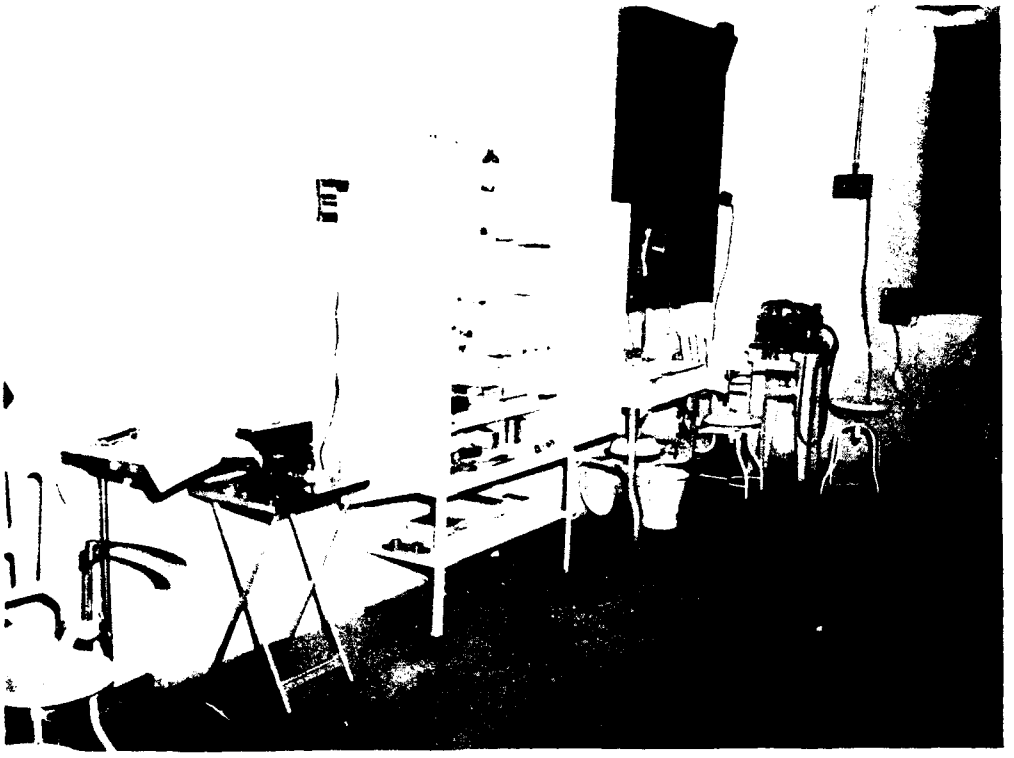


FIGURE 3. Interior view of eye, ear, nose, and throat clinic of the 28th Station Hospital.

tion. In one installation, a very satisfactory darkroom was improvised in a corner of the waiting room by the use of a quarter-circle rod from which three blankets were draped.

In overseas installations which occupied fixed civilian structures (fig. 3), facilities for otolaryngologic work were on the whole satisfactory, though rewiring and the placement of base sockets were often necessary to provide for the required lighting and the use of suction apparatus and other special equipment. In a few instances, it was necessary to widen doors to permit passage of wheelchairs and litters.

Ward facilities were also generally satisfactory, though some officers, while not objecting to the joint administration of the services, preferred to separate otolaryngologic, ophthalmologic, and dental patients from each other by the use of temporary partitions extending halfway to the ceiling. Similar partitions were sometimes used to provide private rooms for very ill patients.

In some hospitals, otolaryngologic operations, including major surgical procedures, were done in the outpatient clinic. This plan was entirely satisfactory to the operating-room staff, since it relieved them of the responsibility of a narrow specialty, and it was equally satisfactory to the otolaryngologists, since it permitted the use of their own experienced personnel. The use of

the dispensary for surgical procedures was a particularly desirable expedient when the main operating rooms were handling large numbers of casualties. In installations not provided with specialty operating rooms, the decision as to where operations should be done was usually arrived at after consultation by the commanding officer, the chief of the surgical section, and the otolaryngologist.

Equipment.—Only minimum otolaryngologic equipment in the way of chairs, tables, and similar items was provided for hospitals overseas, and many units designed and made their own furniture. Otolaryngologists at a number of hospitals suggested that a chair be provided for otolaryngologic treatments which, like the dental chair, could be dismantled and carried in a minimum of space. Many officers preferred to use dental chairs instead of the otolaryngologic chairs provided and borrowed them whenever possible. It was frequently pointed out that the provision of a second chair for otolaryngologic treatments would save a great deal of time.

Light bulbs of the American screw-base type were practically unobtainable in the European Theater of Operations, and difficulties arose when those supplied for the portable otolaryngologic examining- and operating-room lamps burned out. These were apparently the only types of lamps for which bulbs were not supplied in the tables of equipment.

Most quonset and nissen huts were well heated and were provided with water-softening outfits. Heating equipment was not always satisfactory, however, in fixed civilian installations.

Instruments.—During the 2 weeks in which the senior consultant in otolaryngology for the European theater was assigned to duty in the Surgeon General's Office before he went overseas, he reviewed the authorized tables of equipment for this specialty but had time to recommend only minor changes in them. During 1943, as the professional service was observed and requirements were clarified, the Supply Division was requested to make numerous other changes in equipment, chiefly the deletion of obsolete items, reductions in the number of items provided in excess, increases in supplies for installations carrying heavy outpatient loads, and the provision of certain special instruments for the treatment of special otolaryngologic conditions.

Changes recommended in the tables of equipment in 1943 were seldom reflected in the provision of instruments overseas until 1944. Thereafter, as the result of these changes and of the extraordinarily capable medical supply service in the theater, the supply of instruments was entirely satisfactory and their distribution was generally excellent.

An additional difficulty in the provision of specialty instruments in 1943 arose from the heavy losses in Atlantic sinkings. Several hospitals arrived, for this reason, without any specialty equipment at all, and for a time their operations threatened to be curtailed. The situation was remedied by cooperation between the senior consultant in otolaryngology and Brigadier Myles L. Formby, the otolaryngologic consultant in the Royal Army Medical Corps, and many

special items were supplied through British sources. At one period, because of the unpredictability of the submarine menace, consideration was given to the possibility of relying entirely upon British sources.

The chief difficulty in the use of British supplies arose from technical differences in terminology, which caused confusion in the use of their catalog numbers. The supply depots were most cooperative, however, and as the result of a survey by Maj. E. P. Fowler, Jr., MC, in the course of which United States Army catalog numbers were attached to British items, the situation was clarified, and the difficulties in respect to supply were eventually completely obviated.

In evaluating the comments upon equipment made by otolaryngologic officers, it had to be remembered that personal desires and idiosyncrasies undoubtedly colored many of their reports. Otolaryngology is a specialty in which many surgeons develop individual preferences, and it would be obviously impossible, as well as unfair, to evaluate Army equipment on any such basis. The majority of officers who were critical of equipment and supplies were fair in admitting the personal basis of their criticisms. Nonetheless, certain adverse criticisms are justified.

On the first inspection of hospitals in the United Kingdom in February 1943, the senior consultant in otolaryngology observed, in addition to a serious general deficiency in electric power, deficits in suction apparatus, endoscopes, and audiometers (p. 397). Suction pumps were usually in sufficient supply but had been equipped with motors requiring 110-volt current, which was usually unavailable; for all practical purposes, therefore, these pumps were in short supply. As of 31 January 1943, only one hospital in the United Kingdom had full endoscopic equipment. Three others had most of the necessary items but lacked such essential equipment as battery cords, suction tips, and bronchoscopic forceps.

Specific complaints made by reporting officers included the following:

1. A lack of punch forceps of all types for nasal work. As a result, antrotomy was performed with difficulty.

2. Deficits of tracheotomy tubes in evacuation hospitals, whose supplies were depleted by the fact that tracheotomized patients were necessarily evacuated with tubes in situ. Similar deficits were observed in some field hospitals, which occasionally had to be supplied from evacuation hospitals.

3. An inadequacy of small nasal specula. One hospital, with a load of 50 or more patients daily, had only two of these instruments.

4. An inadequate number of cutting and punch-type intranasal instruments, though there was usually an excess of such instruments as ethmoid curettes and obsolete antral trocars. One hospital had six sets of Mosher ethmoid curettes and two sets of Coakley sinus curettes, but no instruments for external approach to the ethmoids and sphenoids.

The most universal complaint concerning instruments had to do with

shortages of tonsillectomy instruments. Tonsillectomy, even when strictly limited according to directives, was the commonest of all elective otolaryngologic procedures, but only 1 snare was authorized for a general hospital of 1,000 beds. One evacuation hospital had neither snares nor tonsil forceps in its equipment. A supply of forceps was finally obtained, but the hospital continued to lack snares until the need was supplied from captured German equipment.

Many officers complained about the type of snares supplied, as well as about the quality of the wire, which was likely to break at a critical moment in the operation. The comment was generally made that wire should be supplied on spools. When it was precut or prebent, it was likely to break at the bends, especially after it had been stored in a damp climate for any length of time.

Most of the criticisms listed concerned supplies provided in 1943 and early in 1944. By 1945, complaints about the quality and supply of instruments had greatly decreased, although there was still a deficiency of instruments for minor intranasal procedures, antral punctures, mastoidectomies, and laryngeal operations. Certain equipment was also not satisfactory. The suction machine provided (Item 377500) was much too light for the load expected. It should have had a one-half horsepower motor equipped for 50–60 cycle current, with an attached transformer to use 100–230 volts. It would also have been improved by larger bottles and a larger rotary pump. An electrically lighted nasopharyngoscope should have been supplied for each hospital.

Equipment for auditory testing. The equipment for auditory testing was the most unsatisfactory otolaryngologic equipment supplied in the European theater. Some hospitals had no tuning forks and could not carry out the simplest qualitative tests until these instruments were secured from stores of captured German instruments near the end of the fighting in Europe.

The situation in respect to audiometers was not satisfactory at any time in the European Theater of Operations. When the senior consultant in otolaryngology arrived in the theater in January 1943, only the 5th General Hospital possessed an audiometer, and 2 months later there was still no current available for its use. By 1944, 30 audiometers had been delivered, but every one of them had been received in a damaged condition, and extensive and time-consuming repairs were necessary before they could be used. British sources, through which repairs had to be made, could not handle more than one per week, which meant that, at the end of 1944, many hospitals still lacked this equipment, although it was essential for determining the degree of hearing impairment resulting from blast injuries and other causes, as well as for the identification of malingerers.

These difficulties continued throughout the hostilities in 1945. Numerous audiometers arrived damaged beyond repair. The heavy condenser in the instrument, which was not securely fastened, frequently became loosened in transport and caused extensive damage. Audiometers are of such delicate

construction that even transit in the United Kingdom sometimes put them out of commission.

At the end of hostilities, the conclusion was inescapable that audiometers used in civilian otology were not satisfactory for military purposes and that some special type of instrument sturdy enough to tolerate overseas shipment must be devised if military necessities ever again arise. At the close of the fighting in Europe, it was the advice of the senior consultant in otolaryngology that none of the instruments in the theater be brought back to the United States and that the stock be disposed of overseas for whatever it might bring.

PATIENT LOAD

Official reports showing the number of patients hospitalized on otolaryngologic services provided no indication of the real patient load, either in the Zone of Interior or overseas. This was chiefly because of the large outpatient dispensaries operated in connection with every station hospital and most general hospitals. During 1944, in the European Theater of Operations, about 42,500 patients were admitted to otolaryngologic wards, and approximately 102,000 consultations were answered on other wards. During the same period, approximately 434,500 individual visits were made to outpatient dispensaries. In the United Kingdom before D-day, the outpatient load of some general and station hospitals was often 40 to 60 percent otolaryngologic, and in many installations the otolaryngologic dispensaries were exceeded in size only by the orthopedic dispensaries.

The otolaryngologic patient load, like the character of the work, varied according to the proximity of the installation to noncombat troops and its distance from the active fighting front. At the 52d General Hospital in the United Kingdom, for instance, the average outpatient load per month for 22 months was 1,800. At the 216th General Hospital, which functioned as a station hospital in the United Kingdom for 14 months and which served thousands of troops in an adjacent marshalling area before D-day, between 1,600 and 2,000 outpatients were seen monthly. At the 160th and 192d General Hospitals in England, about 800 patients were seen each month after D-day in the outpatient dispensaries.

The changing experience of the 298th General Hospital as it moved from one locality to another may be cited as typical of the fluctuating patient load and the differing character of work under various phases of military conditions. At Bristol, England, where the hospital was stationed for 18 months, 666 inpatients and 5,132 outpatients were treated, and 501 operations were performed. At Cherbourg, France, where it functioned for 4 months, 273 inpatients and 1,438 outpatients were treated, and 84 operations were performed. At Liége, Belgium, where it functioned for 8 months (6 months before and 2 months after V–E Day), 377 inpatients and 2,890 outpatients were treated, and 288 operations were performed.

The point was made by numerous otolaryngologists in their final reports that while many patients seen in the outpatient dispensaries were eventually found to have no pathologic basis for their complaints, it frequently required more time and effort to establish that fact than it did to treat those with obvious diseases.

EVACUATION AND DISPOSITION

Evacuation and disposition policies in the European Theater of Operations changed several times, in response to militiary necessities. Before D-day, every soldier who could possibly be kept in service was kept, even if he could do only limited duty. So urgent was the need for conservation of manpower at this time that men were retained in service who, from the otolaryngologic standpoint, were below the standards for induction into the Army. As the result of the same policies, hundreds of soldiers arrived from the Zone of Interior with chronic otitis media and mastoiditis, both conditions which were likely to be exacerbated by the conditions under which the Army lived. Men also arrived from the Zone of Interior suffering from deafness of varying degrees, though, under some circumstances, it was possible to remedy their disability by the provision of hearing aids (p. 444).

Officers in charge of large outpatient dispensaries at station hospitals, particularly in base sections overseas, frequently called attention to the multiple problems of disposition and reclassification which were introduced by the inadequate examination of soldiers or by their incorrect evaluation before they were sent overseas. The task of making fit for duty or otherwise determining the disposition of soldiers with severe septal deviations, hypertrophied and diseased tonsils, chronic suppurative otitis media, chronic sinusitis, and severe degrees of deafness was very heavy. Resort to surgery in such conditions was not the rule except in very urgent cases, and in most instances reclassification procedures, with appropriate recommendations, were accomplished.

On all hospital wards, the policy was to make patients ambulatory as promptly as was consistent with the exigencies of their condition and then, without additional delay, to return them to duty or recommend other appropriate disposition. The delays which arose from administrative details were always unfortunate, particularly between November 1944 and April 1945, when every man was desperately needed in the field. Prolonged hospitalization had other disadvantages besides the loss of needed manpower. The association in hospital with wounded, sick, neurotic, and malcontent patients frequently had a bad effect on the morale of even good soldiers. Furthermore, as in civilian life, the unwisdom of keeping a well patient in a crowded hospital was repeatedly proved; in many men destined for return to duty, other ailments developed during the waiting period. In one instance, a soldier admitted for a minor condition and marked for duty developed a nasopharyngitis which required hospitalization for an additional 4 months.

Toward the end of 1944, the number of otolaryngologic personnel in the European Theater of Operations was so small that it became necessary to return casualties to the Zone of Interior for specialized care because there were not enough specialists available to treat them all overseas. Additional reasons for the heavy evacuation of otolaryngologic casualties at this time were the theater policy (90-day holding), as well as the constant pressure to clear hospital beds for more urgent combat casualties.

In late 1944, an evacuation policy was established which provided that all patients in the following categories, in addition to those with functional neuroses referable to the ears, nose, and throat, would be returned to the Zone of Interior:

1. *Deafened patients.*—These patients were to be treated at general hospitals designated as aural rehabilitation centers before they were transferred to the permanent care of the Veterans' Administration.

2. *Patients with injuries of the larynx associated with trauma to the phonatory and breathing apparatus.*—In injuries of this kind, reconstruction of the airway, plastic repair of the neck and lower jaw, and voice training and esophageal phonation were required for complete rehabilitation.

3. *Patients with damaged facial nerves.*—In these cases, repair was carried out in association with plastic surgery on the face. It was the policy to explore the course of the nerve and possibly to attempt nerve grafting before resorting to other methods of treatment.

4. *Patients with chronic suppurative otitis media.*—As already noted, many patients were sent overseas with this condition, while in others it developed as the result of military operations, the masking effects of chemotherapy, and inadequate treatment by nonspecialists early in the disease.

5. *Patients with paranasal sinusitis.*—Many were inducted with this condition, and, while some improved, others became worse overseas. In some instances, severe exacerbations of chronic sinusitis were caused by facial injuries. It is the opinion of many otolaryngologists who were in service that foreign bodies, apparently innocuous at the time of wounding, may be etiologically important in many cases of this kind.

TRAINING

Basic training.— Reports to the senior consultant in otolaryngology by otolaryngologic officers showed no uniformity of Army training in otolaryngology. Officers who had had previous service in the Reserve Officers Training Corps and the National Guard did not consider that their service in these organizations had been of special value in the professional work they were called upon to do in the Army.

Officers sent to the Medical Field Service School, Carlisle Barracks, Pa., for a 6 weeks' period of training reported almost without exception that an amazing amount of medicomilitary information could be learned in a short time by highly efficient methods of instruction utilized at that school. The

physical training received there was regarded as necessary. The explanations of the functions of the Medical Department and of combat units were considered of value, regardless of later assignment. Almost the only unfavorable comments on the course were (1) that it might be well to make clearer the actual organization of various hospital units, and (2) that it was unfortunate that in a few instances officers attending the Medical Field Service School were recalled to their units before the courses had been completed.

Officers assigned to station hospitals in the Zone of Interior or to evacuation and other hospitals overseas for orientation reported that the periods spent in these installations had been of great value in teaching them not only the paperwork required in the Army and the details of Army administrative methods but also the details of military medicine as they differ from those of civilian medicine.

Officers assigned to the Medical Field Service School for 4 months or longer believed that the time was largely wasted from the standpoint of professional care of patients, which was their primary mission. All comments were to the effect that close-order drill, map problems, the manual of arms, and similar matters were not related to their professional mission and that the time and energy spent on them could have been more profitably spent on matters of real medical value, particularly in training in traumatic and maxillofacial surgery.

Officers who served in affiliated units, who had worked together for years, and who were trained as a group, considered that their training had been well coordinated and was of real value. Officers without military training, who were sent directly to Army duty after induction, usually thought that their Army service would have been more competent if they had had a certain amount of military orientation.

In general, comments on the basic training received by otolaryngologists were to the effect that

1. Some training in military administrative details and military medicine was essential, but that intensive training along lines not likely to be of future usefulness, such as road marches, close-order drill, bivouacs, and the manual of arms, represented time wasted for medical officers who were to perform otolaryngologic specialty duties in general or station hospitals.

2. Training in Army paperwork, boarding of patients, management of wards and clinics according to Army routine, and similar matters was essential.

3. Intensive training on the management of war wounds in general and on the management of certain types of casualties in particular was so essential that every otolaryngologist should receive it.

4. Training in maxillofacial surgery might better be given to the otolaryngologist, because of his basic knowledge of the anatomy of the face and neck and of general surgical principles, than to the dentist.

5. Any otolaryngologist to be put in charge of the otolaryngologic department in a general or station hospital should be trained in bronchoscopy, if he was not already qualified in this technique.

Otolaryngologic training in the European Theater of Operations. The system of regional consultants in otolaryngology would have solved all personnel deficiencies in the European Theater of Operations had a formal training system been permitted. Such a program was not established, however, chiefly because of the belief held before D-day and not borne out by later events that all hospitals sent ovesreas would be adequately staffed with specialty officers. It was also thought that the sick and wounded should not be subjected to untrained care, under the guise of specialty skills, while officers without previous training in otolaryngology thus qualified to become specialists.

The policy of transferring patients in need of specialized care to specialized centers, which was practical in all but a small proportion of cases, made it unnecessary to assign widely experienced otolaryngologists to every Army medical installation. Less intensively trained men could readily and safely care for 80 percent or more of all otolaryngologic conditions. The provision of all specialists was the function of the Zone of Interior, but, if the shortages in specialized personnel which developed as the war progressed had been foreseen in 1943, the institution of a training program in the European theater would have provided better specialized care for the troops overseas than they eventually received.

Training was permitted in the European theater in only four instances. Two officers whose training in otolaryngology had been interrupted by induction into the Army and a third who had had some specialty training in the Army were ordered on detached duty to general hospitals in which their earlier training could be augmented. A fourth officer, without previous otolaryngologic experience, was permitted to receive training. The effort expended on these four officers proved fully justified. They were not qualified to serve as chiefs of section, but all of them functioned most creditably as second officers in fixed installations, and the usefulness of the chiefs of section in these institutions was thus greatly increased.

In the latter part of 1943, the policy was adopted of ordering specialists from newly arrived units to well-functioning hospitals, where they served on detached duty for 1-month periods before they were assigned to permanent duty. As a result of this policy, otolaryngologic services of newly arrived units usually functioned smoothly as soon as they were activated, because section chiefs, already competent professionally, had become familiar with theater policies.

A course in maxillofacial surgery, at the plastic center at East Grinstead, England, and another, in the management of diseases of the paranasal sinuses, at the Head Center in Oxford, were attended by several otolaryngologists, but the highly specialized character of both courses somewhat limited their usefulness.

Many otolaryngologists, in their final reports to the senior consultant in otolaryngology, stated that, in their opinion, the periods they had spent in staging, when specialized work was practically paralyzed, could have been

spent far more usefully on detached duty in other hospitals, where they might have worked under experienced otolaryngologists. In theory, this plan is excellent. In practice, it might not have been effective, for what was permitted to one inactive specialist should, in fairness, have been permitted to all, and the resulting situation might well have been chaotic.

DISSEMINATION OF INFORMATION

One of the first official acts of the senior consultant in otolaryngology on his arrival in the European Theater of Operations was to request that the theater be supplied with journals relating to the specialty. The supply, unfortunately, was never adequate. Hospital libraries had fairly good assortments of texts on otolaryngology, though there were some complaints concerning a lack of comprehensive material on bronchoscopy and esophagoscopy. Medical dictionaries were frequently in short supply.

Information of an official character was disseminated by directives from the Surgeon General's Office and from the Office of the Chief Surgeon. Other information was usefully imparted by meetings with various groups at hospital centers and hospitals, where frank and informal discussions were possible concerning policies in the European theater and data secured from other theaters. A deliberate attempt was always made to make clear to surgeons in base hospitals the conditions under which frontline work was done and to emphasize to surgeons in forward areas the importance of following established policies, if for no other reason than that the initial treatment could influence, favorably or otherwise, the final therapeutic results.

Rotation of officers.— The advantages of visits between hospitals and of the actual exchange of personnel between front and rear areas were fully recognized, and it was possible, in the last weeks of the fighting in Europe, to put the plan into effect in some areas. It was unfortunate that it could not have been introduced earlier. In addition to the advantages which always accrue from observing the work of others, surgeons in base hospitals, having seen conditions at the front, were better able to understand the problems in that area, while surgeons in forward areas, having seen the condition in which patients arrive at the base, were able to plan improvements in procedures and could comprehend why instructions concerning debridement and similar procedures had to be followed implicitly.

Instruction of nonspecialized personnel.—Various methods were used to instruct medical officers without previous training in the principles of otolaryngologic care of battle casualties. In 1943, Colonel Canfield participated in the instruction, at the Medical Field Service School at Shrivenham, England, where he gave 8 lectures of 1 hour each on first aid in injuries of the ear, nose, throat, sinuses, mouth, and larynx. Instruction at this school continued until D-day. Special emphasis was placed on the type of casualties likely to be seen in the field and on the methods of treatment which would permit their evacuation in

the best possible condition to rear hospitals for definitive surgery. The lectures were constantly revised as material on otolaryngologic casualties accumulated from other theaters, particularly the Mediterranean. After D-day, when personal observation of casualties returned from the front became possible, discussions were initiated concerning the types of injuries observed, the condition of the patients, and methods of treatment.

The otolaryngologic section of the Manual of Therapy, European Theater of Operations, was rewritten after D-day, and brought into line with what had been learned from personal observation of battle casualties.

In May 1945, the Medical Field Service School was moved to Paris, and a 1-hour period was allotted to otolaryngology in each course. The lectures, which were given by Maj. Otto Hensle, MC, of the 1st General Hospital, and by the senior consultant in otolaryngology, consisted of 40 minutes of didactic instruction, followed by a 10-minute question period. The subjects covered included control of hemorrhage by pressure, ligation, packing, and the use of the suction apparatus; injuries to the ear, with emphasis on rupture of the tympanic membrane; injuries to the nose, with emphasis on fractures, dislocations, cerebral lacerations, and spinal fluid rhinorrhea; injuries to the sinuses; injuries to the throat; injuries to the larynx, with emphasis on the maintenance of an airway; tracheotomy, with special emphasis on the type of incision (vertical), the use of improved tubes as necessary, and postoperative care. It was the opinion of the senior consultant in otolaryngology that no significant amount of useful information could be imparted regarding the specialty by this archaic method of teaching.

LIAISON WITH ALLIED MEDICAL OFFICERS

In accordance with his instructions from the Chief Surgeon of the European theater, the senior consultant in otolaryngology, soon after his arrival, established liaison with British otolaryngologists. The initial contact was with the otolaryngologic consultant for the British Army, Brigadier Myles L. Formby. Liaison was later established with the Canadian consultant, Col. J. A. McFarlane, and with appropriate officers and officials of the United States Navy, Royal Air Force, Ministry of Health, and Oxford Medical School.

These contacts proved of value for both British and United States medical officers. When the supply of instruments for United States Army hospitals was short, in the early days of the European theater, they made it possible to utilize British supplies (p. 395). The war had greatly depleted the ranks of British specialists, and arrangements were made to care for British troops in United States Army hospitals; the policy was continued until D-day. This service was expanded by placing United States Army otolaryngologists on temporary detached duty in British Army hospitals, a policy which proved so valuable to United States observers that later, several specialists were sent to British hospitals on detached duty for 1-month periods and Capt. A. C.

Johnson, MC, of the 67th General Hospital, was assigned to the Oxford Military Hospital for 3 months. Many officers expressed the opinion in their final reports that an extension of this plan would have been very profitable, particularly before D-day, when work was light in their own installations.

After the liberation of France and Belgium, French and Belgian hospitals were frequently and profitably visited by United States Army otolaryngologists.

Meetings.— Opportunities of attending medical meetings in England, especially the meeting of the Otologic and Laryngologic Sections of the Royal Society of Medicine and the Royal College of Physicians, proved very helpful. In June 1945, approximately 40 otolaryngologists stationed in the United Kingdom were able to attend the annual banquet of the Royal Society of Medicine. When the Paris area was established, American otolaryngologists attended the meetings of the Société Otorhinolaryngologie des Hôpitaux de Paris and participated informally in the discussions.

In addition to the informal meetings held with the staffs of United States Army hospitals and the meetings with British and French medical societies, other meetings were attended by American otolaryngologists. The inter-Allied medical meetings in London were well attended by officers stationed in the vicinity, and meetings of United States Army otolaryngologists held in the same city in June and in December 1943 were participated in by British officers. Circumstances in 1944 did not permit similar inclusive meetings, but smaller meetings were held at various centers in the United Kingdom to discuss matters of otolaryngologic concern in the theater.

At the Liége Hospital Center, where interchange of visits between hospitals was encouraged by the commanding officer, monthly professional and social specialty meetings were held, and the following topics were discussed: Crushing wounds of the sinuses, penetrating wounds of the larynx, local penicillin therapy of paranasal sinus infections, the blast syndrome, intravenous ether in endoscopy, objective tinnitus, masked mastoiditis, endoscopic removal of shell fragments from the tracheobronchial tree, lateral pharyngeal abscess and thrombosis of the internal jugular vein, and secondary hemorrhage in wounds of the neck and head.

Informal meetings were frequently held between the British and United States otolaryngologic consultants, with profitable discussions on comparative methods of treatment and disposition of patients.

RELATIONSHIP WITH ARMY AIR FORCES

The function of the senior consultant in otolaryngology with respect to the Army Air Forces was entirely advisory, since the Air Forces had its own hospitals and its own professional staff.

On Colonel Canfield's arrival in the United Kingdom in January 1943, contact with the Air Forces was established through Col. Malcolm C. Grow, MC. During 1943, several lectures on nasal physiology and the treatment of acute

infections were given at the Army Air Forces School at High Wycombe. In 1944, a 2-hour course of instruction was given at the Air Forces Provisional Medical Field Service School. In the first hour, much the same material was presented as was presented in the similar course at the Ground Forces School. The second hour was occupied with a discussion of special problems of fliers. The principal topic of discussion was the effect of changing atmospheric pressures, including the problems of hearing during high-altitude flying and the relief of intratympanic pressure by the transtympanic route. When the course was repeated later in the year, additional material was included on myringopuncture, aero-otitis media, and the treatment of nasopharyngitis by radium.

In 1944, liaison with the Army Air Forces was greatly facilitated by visits of the senior consultant to airfields and visits of Army Air Forces medical officers to hospitals in the vicinity of their own fields. At intervals, the recommendation that an otolaryngologic consultant be assigned full time to the Army Air Forces, because upper respiratory infections in aviators are a constant problem, was considered but was never implemented.

TOUR OF MEDICAL INSTALLATIONS ON CONTINENT

A tour of medical installations on the Continent was made by the senior consultant in otolaryngology, accompanied by the senior consultant in ophthalmology, between 31 July and 6 August 1944. A summary of the observations made during this tour will make clear the instructional value of such tours and will also throw light upon the functioning of the consultant system and the liaison between the consultants in the various specialties. The tour included visits to 2 general hospitals, 5 evacuation hospitals, 4 field hospitals, 3 medical battalions, and 1 auxiliary surgical group.

The tour began with conferences with Col. James B. Mason, MC, Col. Irving A. Marshall, MC, and Col. Robert M. Zollinger, MC, at the Office of the Surgeon, Advance Section, Communications Zone (Col. Charles H. Beasley, MC). Permission was given to visit any medical organizations in the Army area, without restriction. These conferences, as well as a conference with Col. Joseph A. Crisler, MC, consultant in surgery, Office of the Surgeon, First U. S. Army, and Col. James L. Snyder, MC, executive officer, Office of the Surgeon, First U. S. Army, were of great help, one reason being that they included a full description of the policy of definitive surgery under which the Army operated.

Otolaryngologic considerations.—At the 2d Evacuation Hospital, the commanding officer, Col. William F. MacFee, MC, had already obtained full information about the risks of undrained maxillary sinuses and had communicated it to his otolaryngologist, Maj. Duncan R. McCuaig, MC, who was doing excellent work. Particularly good work was also being done at the 77th Evacuation Hospital by Maj. (later Lt. Col.) Edwin S. Wright, MC.

At the 5th Evacuation Hospital, although a qualified otolaryngologist was on the staff, maxillofacial surgery and otolaryngologic surgery were being handled by the maxillofacial member of an auxiliary surgical team. Errors were being made. A pharyngeal swelling, for instance, had been approached from the cervical aspect, without consultation with the otolaryngologist, and it was evident, from conversation with him, that the surgeon who had handled the case had no appreciation of the importance of proper drainage in such injuries and of adequate postoperative care of the nasal cavity. This information was communicated to both the chief of the surgical service and the commanding officer of the hospital, and it was recommended that there be closer cooperation in the future between the maxillofacial surgeon and the otolaryngologist.

At the 24th Evacuation Hospital, the cooperation between the otolaryngologic service and the dental service was excellent. Later, after Colonel Canfield had returned to the United Kingdom, he observed a patient who had been treated for a facial wound at this hospital, without adequate debridement. This information was sent to the Surgeon, First U. S. Army.

At the 101st Evacuation Hospital, where both an ophthalmologist and an otolaryngologist were on the staff, there had been considerable lethargy in setting up the clinic to handle these specialties. Specific suggestions were made for improving this situation.

At the 298th General Hospital, housekeeping difficulties were evident. The building was old, rambling, without elevators, with high ceilings, and difficult to keep clean. It had been occupied, in turn, by the French Navy, the Germans during the occupation, and finally by the 8th Field Hospital. The otolaryngologic clinic, however, under Maj. (later Lt. Col.) Joseph B. Farrior, MC, was functioning well. Equipment was good, though the electric current was not always satisfactory.

At the 5th General Hospital, the location of the operating room immediately adjacent to the power plant of the hospital provided the surgeons with a number of distressing problems.

An extremely interesting case was observed at this hospital. A bullet which had penetrated the shoulder, injuring the nerve, had passed into the neck and come to rest half in and half out of the trachea. When its removal was attempted, it slipped completely into the trachea and passed into the right main bronchus. Tracheotomy had to be done because of the unsatisfactory respiration, which was later found to be caused, at least in part, by pneumothorax. The bullet was skillfully removed by Maj. (later Lt. Col.) Carlyle G. Flake, MC, through the tracheotomy wound. Following this procedure and evacuation of the pneumothorax, the patient's condition promptly improved.

General observations.—The 77th Evacuation Hospital, which was handling large numbers of head injuries, needed certain neurosurgical instruments as

well as fibrin foam. These needs were communicated to Col. R. Glen Spurling, MC, senior consultant in neurosurgery.

The anesthetist at the 5th General Hospital reported that the 67th Evacuation Hospital badly needed a qualified anesthetist. This fact was communicated to Lt. Col. Ralph M. Tovell, MC, consultant in anesthesia.

The 2d Platoon of the 51st Field Hospital had a bronchoscope in need of repair. Recommendation for its replacement was made to a member of an auxiliary surgical team.

Supplies of whole blood were inadequate in some installations, notably the 104th Medical Battalion, 29th Infantry Division.

Policies in regard to definitive surgery did not seem clear at all the organizations visited. Discussions were initiated concerning the condition of patients previously observed in the United Kingdom Base, some of whom had not had adequate debridement, and the importance of this procedure was emphasized.

Policies concerning the evacuation of patients from one hospital to another did not always seem to be clearly understood. At the 10th Evacuation Hospital, the commanding officer had 50 patients ready to return to duty but had no instructions about procedure. At the 298th General Hospital, the 10-day evacuation policy then in force was creating difficulties concerning the final disposition of the patients. At the 60th and 61st Medical Battalions, which were jointly operating an air evacuation center, although the load was heavy both policies and practices were excellent, and cooperation with the Air Forces was good; 1,298 patients had been handled by air in a single day. Evacuation was also by the 11th Hospital Train based at Cherbourg, and by sea. Ambulances arriving with litter and walking wounded were dispatched most efficiently.

The 16th Field Hospital chiefly handled prisoners of war and patients with self-inflicted wounds. There was a striking discrepancy between an inspector general's conclusions that not more than 3 percent of these wounds were really self-inflicted and the suspicion of the medical officers who treated the patients that 75 percent of them fell into this category.

Final conferences and recommendations.—At a final conference with Colonel Beasley and Colonel Mason of Advance Section, the various matters just recorded were discussed, and certain general recommendations were made, as follows:

1. That qualified personnel be employed in their special areas of training.
2. That there be closer cooperation between the specialties.
3. That otolaryngologists should assist in the care of patients with other than otolaryngologic conditions, but only in addition to, and not in place of, work in their own field of training.
4. That triage of casualties be so conducted that wounds of the ears, nose, throat, larynx, trachea, and sinuses be treated definitively either by, or under the supervision of, the chief of the otolaryngologic section in each hospital and not by surgeons untrained in otolaryngology.

5. That policies concerning the removal of foreign bodies be clarified. It was recommended that unless the removal of a foreign body was necessary to permit safe evacuation, operations in transit hospitals should be prohibited for this purpose if definitive treatment could not be provided at the same time. It was also recommended that foreign bodies involving the facial nerve should not be removed unless a surgeon were available who was qualified to explore the nerve throughout its course in the mastoid and adjacent soft parts.

6. That penetrating wounds of the paranasal sinuses should not be operated on unless an otolaryngologist was available to explore the sinus and provide external drainage at the same time. Antral drainage into the nose was recommended as the procedure of choice unless the external wound were sufficiently large to permit observation of the antrum for about a week. Drainage of the frontal sinus through the skin was the method of choice, either through the wound of entrance or through an incision in the floor of the sinus.

7. That debridement of facial wounds include removal of loose pieces of bone and devitalized soft parts.

8. That the formation of synechiae of the nasal mucosa be prevented by the use of gauze packs impregnated with 5-percent sulfadiazine ointment or, when necessary, by removal of portions of the bony or cartilaginous septa.

9. That the policy of calling specialists from neighboring evacuation hospitals for patients who needed specialized care in field hospitals should be continued, since it had proved to be successful as well as economical of personnel.

At the time this tour was made, evacuation practices furnished the chief difficulties, because of the necessarily rapid movement of hospitals in an active campaign. It was expected that these difficulties would vanish as more general hospitals began to operate.

The various points discussed were for the most part well appreciated in the Office of the Surgeon, Advance Section. Most of the undesirable practices reported were already in process of correction, and most of the recommendations made were already in process of implementation.

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CHAPTER II

Clinical Policies in Otolaryngology

Norton Canfield, M. D.

HISTORICAL NOTE [1]

In World War I, examination of the first increments of the draft which arrived at Army camps was conducted by regimental medical officers, otolaryngologists seeing only those men especially referred to them. This procedure was shortly changed, and the examination of the ears, nose, and throat of all recruits was conducted entirely by specially designated officers assigned from the otolaryngologic service. In many camps, reexamination of men already accepted resulted in numerous discharges for disqualifying defects. Malingering did not account for many cases, but it furnished serious problems until definite instructions were issued concerning it.

In general, professional medical care was required for the same conditions in the Army as in civil life. Since several nasal and pharyngeal defects were not regarded as causes for rejection, many men inducted into the Army required otolaryngologic treatment to make them fit for service. The volume of work was very large. In one base hospital alone (Camp Sherman, Ohio), during 1918, 7,311 new patients were treated, 35,261 treatments were given, and 2,226 operations were performed. At this installation, during this period, tonsillitis furnished the largest number of cases in any of the otolaryngologic diseases (1,590) and tonsillectomy the largest number of operations (1,040). From 1 April 1917 through 31 December 1919, acute tonsillitis was responsible for 141,067 primary admissions to sick report in the United States and was a secondary diagnosis in approximately 8,750 other cases. Chronic tonsillitis was the primary diagnosis in 21,618 cases and was the secondary diagnosis in about 7,020 cases. No accurate records are available concerning the total number of tonsillectomies performed in all Army hospitals.

While tonsillitis was the most frequent of all otolaryngologic conditions, otitis media was the most important. The majority of acute cases were observed during the epidemics of acute infectious disease, especially measles and influenza, which occurred during the war and the period of demobilization, though the statistics (25,178 primary diagnoses and approximately 11,000 secondary diagnoses) make no distinction between acute and chronic cases.

[1] The Medical Department of the United States Army in the World War. Washington: Government Printing Office, 1924, vol. XI, pt. 2, sec. V.

Chronic otitis media was a cause of rejection for service, but it was frequently overlooked in the induction examination, and a flareup under the rigors and exposure of military life accounted for most of the cases in this category which required treatment.

Little military surgery, in the true sense of the word, was necessary in hospitals in the United States. Patients with destructive gunshot lesions involving the otolaryngologic structures usually arrived in this country by the time the reparative process had proceeded to such a degree that only plastic surgery was required, and they became the responsibility of maxillofacial surgeons.

OTOLARYNGOLOGIC DISEASES IN WORLD WAR II

Tonsillitis

In World War II, tonsillitis was the second most frequent otolaryngologic diagnosis, the number of cases of this condition being exceeded only by the number of cases of nasopharyngitis both in the Zone of Interior and overseas (tables 1, 2, and 3). Numerous observers were of the opinion that men with enlarged tonsils were more frequently troubled by them in England than they had been in the United States.

Elective tonsillectomy was discouraged except on definite and clear-cut indications. Data are available only for 1945. In that year, tonsillectomies were performed on 85 percent of the patients with chronic tonsillitis in the United States and on 73 percent of similar patients overseas. If it be assumed that the proportions for 1945 were the same for the entire war period, it can be estimated that about 217,000 tonsillectomies were performed among approximately 265,000 patients with chronic tonsillitis (the number of cases including new admissions, readmissions, and secondary diagnoses). Figures are not available for tonsillectomy in acute tonsillitis, but it is a fair assumption that the number of such operations was negligible.

In World War II, acute tonsillitis was treated by simple routine measures. Acute streptococcic tonsillitis usually responded well to penicillin given in adequate quantities (3,500,000 units). Tonsillitis caused by Vincent's angina was treated by various methods, including the local application of 20 percent chromic acid, 20 percent copper sulfate, and penicillin, and the systemic use of sulfadiazine and penicillin. It was the general impression that the topical use of penicillin gave no better results than the topical use of other agents.

Tonsillectomy was occasionally required for recurrences of acute tonsillitis or acute peritonsillar cellulitis even after chemotherapy and antibiotic therapy had been properly employed. Posttonsillar abscesses were usually treated by incision between the posterior pillar and the tonsil, and infratonsillar abscesses were treated by incision at the junction of the anterior pillar and the alveolar mucous membrane.

TABLE 1.—*Admissions for selected diseases of the ear, nose, and throat in the United States Army (worldwide): By year, 1942–45*

[Preliminary data based on sample tabulations of individual medical records]

[Rate expressed as number of admissions per annum per 1,000 average strength]

Diagnosis	1942-45		1942		1943		1944		1945	
	Number	Rate	Number	Rate	Number	Rate	Number	Rate	Number	Rate
Tonsillitis, acute	507, 708	19. 93	68, 328	21. 07	153, 989	22. 41	148, 666	19. 08	136, 725	18. 05
Tonsillitis, chronic	208, 697	8. 19	36, 767	11. 34	80, 045	11. 65	57, 675	7. 40	34, 210	4. 52
Hay fever	15, 234	. 60	800	. 25	4, 445	. 65	4, 559	. 59	5, 430	. 72
Nasopharyngitis, acute	2, 437, 785	95. 68	405, 377	125. 02	905, 536	131. 80	639, 402	82. 06	487, 470	64. 35
Nasopharyngitis, chronic	1, 729	. 07	302	. 09	622	. 09	445	. 06	360	. 05
Otitis externa	45, 334	1. 78	4, 063	1. 25	10, 137	1. 48	14, 954	1. 92	16, 180	2. 14
Otitis media, acute [1]	73, 181	2. 87	9, 087	2. 80	22, 086	3. 21	25, 173	3. 23	16, 835	2. 22
Otitis media, chronic	44, 264	1. 74	4, 646	1. 43	16, 839	2. 45	11, 814	1. 52	10, 965	1. 45

[1] Includes cases with acuity or chronicity not specified.

TABLE 2.—*Admissions for selected diseases of the ear, nose, and throat in the United States Army (continental United States): By year, 1942–45*

[Preliminary data based on sample tabulations of individual medical records]

[Rate expressed as number of admissions per annum per 1,000 average strength]

Diagnosis	1942–45		1942		1943		1944		1945	
	Number	Rate	Number	Rate	Number	Rate	Number	Rate	Number	Rate
Tonsillitis, acute	309,085	20.96	57,685	21.71	121,255	23.40	83,245	20.96	46,900	16.00
Tonsillitis, chronic	152,301	10.33	31,497	11.85	64,830	12.51	37,439	9.43	18,535	6.32
Hay fever	10,064	.68	673	.25	3,700	.71	2,766	.70	2,925	1.00
Nasopharyngitis, acute	1,672,827	113.47	358,281	134.84	730,690	140.99	368,006	92.66	215,850	73.63
Nasopharyngitis, chronic	972	.07	248	.09	390	.08	209	.05	125	.04
Otitis externa	13,227	.90	2,246	.85	5,045	.97	3,351	.84	2,585	.88
Otitis media, acute [1]	41,395	2.81	7,251	2.73	15,995	3.09	12,454	3.14	5,695	1.94
Otitis media, chronic	27,749	1.88	3,811	1.43	13,585	2.62	5,693	1.43	4,660	1.59

[1] Includes cases with acuity or chronicity not specified.

TABLE 3. *Admissions for selected diseases of the ear, nose, and throat in the United States Army (overseas): By year, 1942–45*

[Preliminary data based on sample of admissions abstracted from medical records]

[Rate expressed as number of admissions per man-year per 1,000 average strength]

Diagnosis	1942–45		1942		1943		1944		1945	
	Number	Rate	Number	Rate	Number	Rate	Number	Rate	Number	Rate
Tonsillitis, acute	198,623	18.50	10,643	18.17	32,734	19.39	65,421	17.13	89,825	19.34
Tonsillitis, chronic	56,396	5.25	5,270	9.00	15,215	9.01	20,236	5.30	15,675	3.38
Hay fever	5,170	.48	127	.22	745	.44	1,793	.47	2,505	.54
Nasopharyngitis, acute	764,958	71.25	47,096	80.39	174,846	103.59	271,396	71.05	271,620	58.50
Nasopharyngitis, chronic	757	.07	54	.09	232	.14	236	.06	235	.05
Otitis externa	32,107	2.99	1,817	3.10	5,092	3.02	11,603	3.04	13,595	2.93
Otitis media, acute [1]	31,786	2.96	1,836	3.13	6,091	3.61	12,719	3.33	11,140	2.40
Otitis media, chronic	16,545	1.54	835	1.43	3,254	1.93	6,121	1.60	6,305	1.36

[1] Includes cases with acuity or chronicity not specified.

Tonsillectomy, combined with removal of the adenoids as necessary, was seldom followed by complications. In some installations, calcium gluconate and vitamin C were administered orally for 3 or 4 days before operation, to prevent possible excessive bleeding. Capt. Paul M. Osmun, MC, reported from the 2d General Hospital, European Theater of Operations, an unusual complication following the removal of adenoids, in the form of minor lateral facet torsion dislocation of the third or fourth cervical vertebra, as the result of infection of the operative site associated with local edematous loosening of the vertebral ligaments. The dislocation, which occurred on the 4th postoperative day, was corrected on the 10th day, after 48 hours' treatment by chin traction on a slanted bed. The patient recovered completely, but the case was reported as an illustration of "a frightening complication of a supposedly minor operation."

Pharyngitis and Nasopharyngitis

Pharyngitis and nasopharyngitis were observed in military personnel in much the same frequency as in civilian life. In many camps in the Zone of Interior, the arrival of fresh troops was likely to be followed by an epidemic of nasopharyngitis, with its attendant sequelae. Treatment was by the same methods as in civilian life.

Severe cases of nasopharyngitis, in which the middle meatus was full of pus and systemic symptoms were present, were treated with nasal irrigations of physiologic salt solution and with chemotherapeutic agents by the oral route. Antral irrigations and Argyrol packs were sometimes used also. The local application of sulfanilamide powder by insufflation with an air-compressed pump or by hand compression was recommended by some observers. The simplicity of the method, its application to field conditions, and the lack of systemic reactions made the method superficially desirable, but it is doubtful that the results were any better than those achieved by more usual methods. Shrinkage of the inferior turbinates by coagulation relieved nasal obstruction in severe cases. The indiscriminate use of ephedrine products, usually by the patients on their own initiative, sometimes resulted in prolonged nasal irritation.

In an occasional case, following the resolution of a severe attack of nasopharyngitis, operation was performed, including tip resection of the middle turbinate, medial infraction, or submucous resection of a deviated nasal septum. Operations such as these were performed only on strict indications; namely, that the deflection of the septum was in itself sufficiently marked to produce obstructive symptoms and that operation seemed likely to achieve sufficient change in the functioning of the nose to relieve the symptoms. Asymptomatic deviations and minor deviations were never managed by surgery.

Diseases of the Larynx

Elective surgery on the larynx was limited to the removal of polyps, papillomas, and malignant growths. The incidence of carcinoma of the lar-

ynx, though very small, was surprisingly large in view of the young age group represented in the Army. Laryngectomy was done in the majority of cases, but occasionally a patient was treated by the rapid (12-day) method of irradiation devised by Cutler.

Polyps were usually removed through a Jackson laryngoscope and were always examined microscopically for evidence of malignancy. One case was recorded from the William Beaumont General Hospital in which, after benign cicatricial and thickened tissue had been excised through a laryngofissure to provide an adequate airway, similar re-formation by the new tissue was prevented by the use of an acrylic mold placed from the epiglottis to beyond the cricoid cartilage, as recommended by surgeons at the Mayo Clinic, Rochester, Minn. The immediate results, functionally and otherwise, were excellent.

Chronic hoarseness was explained by the causes usual in civilian life. Hysterical aphonia was occasionally observed. At the 2d General Hospital, where 24 cases of conversion hysteria with dysphonic or aphonic manifestations were observed by Maj. E. P. Fowler, Jr., MC, marked hypertrophy of the plicae ventricularis, particularly on the left, was the rule. The larynx was likely to be diffusely injected and edematous, as the result of trauma arising from misuse. Hysterical aphonia usually responded to simple psychotherapy, which was used in cases which did not respond promptly to rest. If pathologic changes in the larynx had occurred, weeks or months might be required for their complete resolution, depending upon the duration and severity of the hysteria.

Otitis Externa

The military experience with otitis externa in World War II disproved at least two concepts of the disease held by those who had had little or no previous experience with it. The first was that it was a disease of low frequency and small consequence. This was very far from the truth. During World War II, there were about 45,000 new admissions for this cause to medical-treatment facilities on an excused-from-duty basis (tables 1, 2, and 3), and each patient under treatment lost, on the average, approximately 11 days from duty. The second mistaken concept was that otitis externa was most often of fungous origin. As a matter of fact, whenever laboratory investigations were possible, they showed that the overwhelming majority of cases were of bacterial and not of fungous origin.

Frequency.—A few specific illustrations will show both the frequency of the disease in special areas and its military consequences. On Guam, Gordon [2] found it second only to trichophytosis as a cause of time lost from duty. Syverton, Hess, and Krafchuk [3] were inspired to their investigation of it on the same island by the realization that it had occurred in 17 of 241 men

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[2] Gordon, A. T.: Otitis Externa. Bull. U. S. Army M. Dept. 3: 245–246, March 1948.

[3] Syverton, J. T., Hess, W. R., and Krafchuk, J.: Otitis Externa. Clinical Observations and Microbiologic Flora. Arch. Otolaryng. 43: 213–225, March 1946.

within 8 months after their arrival. These men had had no aural difficulties when they left the mainland, and they lived and worked under unusually good hygienic conditions. These same observers found otitis externa in 235 (16.2 percent) of 1,453 marines under treatment for all causes while they were in the Marianas awaiting evacuation.

Reardon's [4] observations were made at the 27th Station Hospital in New Caledonia over a 2½-year period, and in Okinawa over a 4-month period before V-J Day. The average number of ophthalmologic-otolaryngologic treatments at the former installation was 800 per month in 1943 and 1,300 per month in 1944. About 20 percent of the treatments were for otitis externa. Simonton's [5] observations were made in New Guinea and the Philippines over a 2-year period. Three hundred and forty-one patients with this condition were treated in New Guinea between May and September, the rainy season, when the incidence is notably increased. Over the same period, there were 74 cases of otitis externa (22 percent) in a series of 336 consecutive patients seen on the otolaryngologic service. On Saipan, according to Zimmerman,[6] at least 20 percent of military personnel on sick call over a 12-month period received treatment for lesions of the external ear supposed to be of fungous origin, though most of them were bacterial.

These observations were confirmed by United States Navy medical officers, as well as by British and Australian medical officers. The experience of Syverton and his associates [7] on Guam has already been mentioned. Beach and Hamilton [8] stated that otitis externa was almost endemic among troops in the Solomon Islands. Nelson,[9] who noted that the condition varied from island to island and season to season, reported that it comprised 50 percent and sometimes 70 percent of the work in naval mobile and base hospitals in the Solomons and the Hebrides over a 15-month period.

Clark,[10] in India, found 525 cases at a British Army otolaryngologic center in Secunderabad in 3,165 new otolaryngologic cases (16.6 percent). Daggett [11] observed the condition in 193 British troops in Malta and mentioned that it was only occasionally observed in Great Britain. He also recalled Morley's description of the same condition in Aden, where it seriously interfered with the efficiency of the troops, since some men spent practically the whole summer in the hospital. Punt [12] described otitis externa of various types in British

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[4] Reardon, W. T.: Use of "Caso-par" Ointment in the Treatment of Otitis Externa. Arch. Otolaryng. 45: 294-297, March 1947.

[5] Simonton, K. M.: Study of Acute Otitis Externa With Special Reference to Secondary Myringitis and Otitis Media. Mil. Surgeon 100: 156-164, February 1947.

[6] Zimmerman, H. A.: Preliminary Report of the Use of Sulfadiazine Bentonite Solution in the Treatment of External Otitis. Mil. Surgeon 98: 426-427, May 1946.

[7] See footnote 3, p. 417.

[8] Beach, E. W., and Hamilton, L. L.: Tropical Otitis Externa; Ear Fungus. U. S. Nav. M. Bull. 41: 599-602, March 1945.

[9] Nelson, R. F.: External Otitis in the South Pacific. Ann. Otol., Rhin. & Laryng. 54: 367-372, June 1945.

[10] Clark, J. V.: Acute Otitis Externa in India. J. Laryng. & Otol. 61: 586-593, November 1946.

[11] Daggett, W. L.: Desquamative Otitis Externa in Malta. J. Laryng. & Otol. 57: 427-446, October 1942.

[12] Punt, N. A.: Otitis Externa Granulosa (Medical Memoranda). Brit. M. J. 1: 989-990, June 1949.

troops in Austria and Northern Italy. Ballance[13] treated 28 cases in 7 months aboard a British destroyer in the eastern Mediterranean. Davis,[14] at an Army base in the tropics (presumably the Pacific), treated 22 patients, of whom 6 required hospitalization. Birrell[15] stated that external otitis was likely to be found in a quarter of all otolaryngologic patients treated by the British Medical Department overseas, and in a sixth of all otolaryngologic patients examined. Basil-Jones[16] reported 77 cases at a Royal Australian Air Force field hospital.

Nor was the disease confined to the area just mentioned. Reeh,[17] who served at the eye and ear clinic at Fort Randolph in the Canal Zone, reported that it was a formidable problem there, where it was prevalent all the year round because the relative humidity was constantly high and the temperature variations were small. The importance of the condition in some parts of the United States can be judged by the extensive studies made by Senturia and his associates.[18] On the other hand, otitis externa was not frequently encountered in cooler parts of the country. Simon,[19] for instance, who treated over 150 patients, 90 of them Navy personnel, in a 6-month period in the Pacific, had seen only 15 cases in a station on the northeastern seaboard of the United States over the same period of time. As he remarked, physicians and patients from different localities are likely to have different conceptions of this disease.

The total Army figures, as well as the figures from special areas, thus show that otitis externa, though a relatively trivial disease as compared with many other diseases, was an important cause of partial and even complete disability from the military standpoint. Its management consumed a large portion of otolaryngologic clinic facilities and occupied a large part of the time of otolaryngologic personnel. Original attacks and exacerbations, and recurrent attacks, resulted in a large loss of duty hours as well as in a loss of efficiency. Some patients occupied hospital beds urgently needed for other purposes, and some soldiers, because their disease was intractable in a tropical environment, had to be removed from combat through the chain of evacuation and eventually returned to the Zone of Interior. Recurrences were frequent after all types of treatment and there was no way of predicting, except by clinical trial, when the ears would become dry under therapy. Had the time factor not been important, persistent treatment would probably have made possible the return to full duty of many men who were evacuated from the Pacific, but, in an active theater of operations, time was not available for such experimentation.

[13] Ballance, G. A.: External Otitis. J. Roy. Nav. M. Serv. 29: 255–258, October 1943.

[14] Davis, E. L.: Mycotic Ear Infections at an Advanced Allied Base. M. J. Australia 30 (pt. 2): 437–438, November 1943.

[15] Birrell, J. F.: Otitis Externa. Brit. M. J. 2: 80–82, July 1945.

[16] Basil-Jones, B. J.: Diffuse Otitis Externa, an Investigation and Discussion. M. J. Australia 1: 169–172, February 1945.

[17] Reeh, M. J.: Treatment of Otomycosis. Ann. Otol., Rhin. & Laryng. 51: 146–152, March 1942.

[18] Senturia, B. H., and Doubly, J. A.: Treatment of External Otitis. III. The Use of Vehicles and Antibiotics in the External Auditory Canal. In vitro studies. Laryngoscope 57: 633–656, October 1947.

[19] Simon E.: Otitis Externa and Its Treatment. Arch. Otolaryng. 42: 123–130, August 1945.

Etiologic agents and predisposing causes. For many years, as already noted, it was the general belief that fungi were chiefly responsible for otitis externa. As more careful laboratory studies began to be made, it became evident that this impression was entirely erroneous and that fungi were responsible for only a small proportion of cases, at most 25 percent. Although facilities were not generally available for elaborate laboratory studies in the Pacific areas, whenever such studies were made this fact was substantiated. The experience of Syverton, Hess, and Krafchuk [20] may be cited as typical. They undertook the investigation of 72 infected ears in 50 patients, after the clinical diagnosis of otitis externa had been made, to determine what fungi were chiefly responsible for the infection, not to find out whether fungi were present at all. To their surprise, fungi were recovered in only 18 instances, and in each of these the fungus present was only one of several pathogens recovered in mixed form. This was substantially the experience of all others who conducted such investigations. *Aspergillus* was the organism most often found, though the mere fact of its presence did not necessarily indicate that it was the primary invader.

Pseudomonas (*Ps. pyocyanea*) was the most frequent of the bacteria recovered from infected ears, with staphylococci next. *Pseudomonas* is not present in normal ears, and its pathogenicity seems to be established by reports of its accidental finding in the contralateral ear, while the other ear was under treatment, and the later development of otitis externa in the previously unaffected ear.

The distribution of otitis externa in World War II supported the general opinion that climate was the chief predisposing cause and that the disease was likely to be frequent whenever the prevailing weather was warm and humid. Other important causes were careless personal hygiene, usually to be explained by the conditions under which the war was fought in the Pacific, and trauma, usually introduced by the patient himself. According to Simonton,[21] otitis externa showed a marked decrease in the dry season in New Guinea and the Philippines, although the temperature was high and more men went in swimming then than at other times; these circumstances suggested that humidity was even more important than heat as the cause of the disease.

Although swimming was thought to be the cause of otitis externa in many cases and although some observers considered it the principal cause, it could not be accepted as a universal explanation of the disease if only because so many men who suffered from the disease had no history of swimming. In certain areas, such as the Solomons, cultural evidence established river water as a prolific source of *Ps. pyocyanea*,[22] but this was infection with a special organism and not infection because of water per se. Syverton and his asso-

[20] See footnote 3, p. 417.
[21] See footnote 5, p. 418.
[22] See footnote 8, p. 418.

ciates [23] found that only 10 of 50 patients who sought treatment for otitis externa had been swimming within 14 days of their first visit and that only 2 of the 10 went in swimming regularly. It was the idea that the expressed opinion of many patients that the onset of the aural disease was precipitated by swimming or that preexisting symptoms were aggravated by water simply reflected current beliefs.

All other predisposing causes, including psychogenic causes, could be identified in occasional cases but were not universally applicable. In a small number of cases, external otitis was the result of infection from a chronic suppurative otitis media, but the majority of observers were inclined to put no great emphasis upon this factor.

The external auditory canal, as always, proved an ideal site for the development of infection, because of its depth, small size, and damp environment. Except in these respects, however, its anatomic configuration did not seem related to the disease. Syverton and his associates,[24] who studied 50 cases of otitis externa from this standpoint, found that the variations from the standard norm were no greater in this group of affected men than would be found in any nonaffected group.

As in civilian practice, the first attack of otitis externa usually represented an entirely fortuitous set of circumstances.[25] Because the external auditory canal is an open channel, it was easy for micro-organisms to gain entrance to it accidentally, from the air or water, or to be brought into it by the introduction of the fingers or of foreign bodies used for cleansing purposes. Once the organisms had been introduced, they were ideally located for growth, since they were in a moist chamber that contains, in the cerumen and cellular detritus normally present, an adequate culture medium to support the growth of many fungi and bacteria. In tropical areas, the moist, hot climate increased the possibilities for initial infection and enhanced the infection once it had become established.

In a great many of the patients observed overseas, the initial attack of otitis externa had occurred overseas. In other instances, however, there was a history of recurrent attacks, sometimes covering many years. It was characteristic to find long-quiescent infections reactivated by the circumstances in which the men found themselves while in service.

Clinical picture.— The clinical picture of otitis externa depended upon the severity and extent of the infection, the causative agent, the time at which the man was seen, and the therapy to which he had previously been subjected. It was quite typical to elicit a story of recurrent attacks, often covering several months, treated with many different drugs and ointments, and sometimes by repeated hospitalization, but never with more than temporary relief. Fre-

[23] See footnote 3, p. 417.
[24] See footnote 3, p. 417.
[25] See footnote 3, p. 417.

quently, too, the story was that a new form of therapy had been tried every time the patient was seen by a different physician.

Otitis externa was never asymptomatic, though sometimes, as already noted, organisms known to cause the disease might be isolated from a contralateral nonaffected ear before clinical symptoms and signs had become evident. Both symptoms and signs were essentially those seen in civilian cases of the disease, though frequently they were aggravated by the circumstances of military life. Itching was likely to be the first symptom. Other symptoms included pain in and about the ear, increased by mastication and frequently worse at night; a sense of fullness in the ear; hearing loss, frequently transient and usually directly proportional to the degree of blockage of the canal by debris or, if middle ear involvement was present, directly attributable to that cause; occasionally tinnitus; and very occasionally vertigo.

Examination of the ear showed, variously, crusting about the orifice and lobe; usually a large amount of debris, described by Reardon [26] as having the odor of new-mown hay; and a narrowed, inflamed canal with edematous walls. Manipulation might be exquisitely painful. Tenderness at the angle of the jaw was characteristic. The discharge might be serous, seropurulent, or purulent, depending upon the causative agent and the stage of the disease. The tympanic membrane had sometimes lost its luster from participation in the inflammatory reaction. If the cause of the external otitis were otitis media, the drum might be ulcerated and perforated. Hemorrhagic blebs sometimes covered the wall of the canal as well as the tympanic membrane. The disease was frequently bilateral, but the two ears were frequently not affected synchronously, and it was the rule, if they were, to find that the two processes were in different stages of evolution.

Syverton, Hess, and Krafchuk,[27] after a study of the material on Guam, formulated the following clinicobacteriologic classification:

Group A.—Symptoms include pain, soreness, a sense of fullness in the ear, and pruritus. Findings include moderate to marked edema of the soft parts, which may extend to the tragus and preauricular tissues, and a yellowish to gray purulent exudate. Laboratory studies reveal *Ps. aeruginosa* in pure culture, together with normal flora or with other bacteria and with fungi.

Group B.—Symptoms include pain, which may be sharp or aching, and a sense of fullness, but not much soreness or edema. Findings include localized erythema, slight edema, and occasional macroscopic pustules demonstrable to otoscopy. The predominant organism is *Staphylococcus aureus haemolyticus.*

Group C.—Symptoms include a sense of fullness in the ear and slight impairment of hearing. Otoscopy reveals macroscopic colonies of fungi, which are subsequently shown to belong to the genus *Aspergillus* or *Actinomyces.*

Group D.—Symptoms include pain, itching, and a sense of fullness in the ear. Physical findings include erythema, edema, and an exudate, which is

[26] See footnote 4, p. 418.
[27] See footnote 3, p 417.

likely to be extensive. Laboratory studies reveal several pathogens, including *Klebsiella*, *Phytomonas*, and *Proteus*.

Therapy.– Since no general instructions for its management were ever issued, the therapy of otitis externa in World War II was always an individual matter. Numerous methods were employed, but with certain outstanding exceptions results were generally unsatisfactory.

As a rule, cleansing of the external auditory canal was regarded as an essential phase of treatment. Many observers, in fact, were of the opinion that, if time had not been a factor of such importance, the patient use of simple cleansing measures would have cleared up many cases permanently. Some feared the introduction of fluids into the ear, but for the most part cleansing was carried out with copious irrigations of water, care being taken to dry the canal thoroughly afterward. Special agents used for cleansing were chiefly peroxide of hydrogen, bicarbonate of soda, and green soap. Debris was removed after the irrigation, preferably with the piano-wire type of tip, the procedure being carried out gently and carefully; sometimes it might take as long as 20 minutes. Most medical officers removed cerumen along with other debris. Philpott and Chessen,[28] contrary to the general opinion, regarded cerumen as "beneficently bacteriocidal" and urged that it be left in situ.

The following are some of the methods used after cleansing had been accomplished:

Gordon,[29] working on Guam, began treatment with the application of a wick soaked in 1 percent phenol in glycerin and kept in place for 24 hours whenever the temperature was elevated and it was not possible to view the drum. Over this period, sulfadiazine was given orally, with aspirin, phenacetin and caffeine for pain, or, in extreme cases, small doses of codeine. When the wick was removed, the canal was gently douched with peroxide solution and dried. Powder containing 4 percent boric acid and 5 percent sulfadiazine in a zinc stearate base was then insufflated into the canal daily for 3 days. After each treatment, a cotton plug was inserted into the canal to keep out moisture. After the last treatment, the canal was again irrigated with peroxide and dried thoroughly. Sulfadiazine was continued by the oral route while local therapy was being carried out. Only a small number of patients required more than a single course of treatment.

In cases of fungous origin, after cleansing of the canal with peroxide, Gordon inserted a wick soaked in a half-strength solution of Castellani's paint. At the end of 24 hours, the wick was removed and the canal swabbed with peroxide. The patient was then given a prescription of 4 percent boric acid and 10 percent acetone in 95 percent ethyl alcohol, with instructions to use the solution as drops 5 times daily for 5 days. If there was any crusting at the end of the sixth day, the whole routine was repeated. Only about a

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[28] Philpott, I. W., and Chessen, J.: Tropical Otitis. Rocky Mountain M. J. 42: 345-347, May 1945.

[29] See footnote 2, p. 417.

quarter of the patients required a second course of treatment, and none needed a third. In mixed cases, the routine for bacterial and fungous therapy was combined, as follows: The canal was first cleansed with peroxide solution and dried. A wick soaked in half-strength Castellani's paint was then inserted for 24 hours, after which insufflations of boric acid-sulfadiazine-zinc stearate powder were used for 3 days, followed by acetone-alcohol drops for 3 days. Only 8 of 79 patients thus treated required a second course of treatment, and none required a third course.

Philpott and Chessen[30] used a 5-percent aluminum acetate solution, which they found superior to any other form of therapy. They found X-ray useful in the occasional acute case but did not think it was needed very often; it was of little value in chronic cases. It should be added that, in many areas of the Pacific in which otitis externa had to be treated, facilities for this form of therapy were not available.

Reardon,[31] in New Caledonia and on Okinawa, had a long and generally unsatisfactory experience with sulfathiazole ointment, Cresatin Metacresylacetate (*m*-cresylacetate), Burow's solution, Gentian Violet Medicinal (methylrosaniline chloride), Castellani's paint, 5 percent phenol and glycerin, ichthammol ointment, silver nitrate, Merthiolate (thimerosal), Metaphen (nitromersol), and penicillin solution. Penicillin not only proved valueless but was the most irritating of the agents used. Most of these methods produced transient benefit, but there was usually a fresh outbreak about the time that cure seemed a possibility. When Reardon learned of the possibilities of substituted benzylamine salts of isoparaffinic acids and was able to secure isopar ointment containing them, he adopted the following plan of management:

After the external auditory canal had been cleansed with hydrogen peroxide and dried, isopar ointment was applied on a $\frac{1}{4}$-inch wick cut from a 2-inch gauze bandage. The wick was removed and replaced at the end of 48 hours. Since the canal was often practically obliterated by edema, great care had to be exercised in placing the first wick. After 3 treatments by this regimen, the intervals of treatment were successively lengthened to 3 days, 4 days, and 7 days. After the ear had become perfectly dry, it was painted with Castellani's paint, which was also used on the intact ear if the condition was unilateral when the patient was first seen. Hemorrhagic blebs were ruptured if the patient complained of pain but otherwise were not disturbed. Notable improvement was usually evident on the second visit, and in severe cases the lining membrane had usually sloughed off en masse by the third visit or soon thereafter. Patients seen early had a prompt response in that itching ceased, pain was controlled, and there was no extension of the process. When the condition was of a more chronic nature, the response was less rapid but was usually uniformly steady.

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[30] See footnote 28, p. 423.
[31] See footnote 4, p. 418.

Another satisfactory method of treatment in the South Pacific was the use of a powder consisting of equal parts of sulfathiazole and boric acid with enough penicillin added to give the completed mixture a light yellow color.[32] This "psb" powder, as it came to be known, was placed in a powder blower and kept refrigerated, ready for prompt use.

The first step of treatment was, as usual, cleansing of the external ear of all exudate and cerumen. This could be done with a solution containing a few squirts of "psb" powder. If the inflammatory swelling was pronounced, it was reduced by the instillation of a hydroscopic solution of penicillin in glycerin kept in situ with a cotton pledget.

After the canal had been cleansed and dried, enough "psb" powder was blown into it to form a thin coating over all the surfaces, including the tympanic membrane. Treatments were given daily until the inflammatory state had been substantially reduced, then as often as necessary to keep a thin coating of powder in the canal. With this treatment, as with all the others, it was important to have the patient return several times at weekly intervals to guard against recurrence.

The formula for this powder was arrived at empirically. An attempt to use penicillin alone in powder form was unsatisfactory because of its deliquescent properties. When penicillin and sulfathiazole were combined, the mixture was still moderately deliquescent, and hard, encrusted particles of sulfathiazole were found in the auditory canal. The addition of boric acid powder did away with these difficulties.

Simonton,[33] who saw an unusual number of cases of myringitis and otitis media secondary to otitis externa, originally performed myringotomy whenever the drum was thickened and full. He soon found that the ear cleared up equally well merely by treatment of the otitis externa. For this purpose, he found no single drug outstanding. He, like several others, emphasized that strong drugs and antiseptics were not well tolerated in the aural canal and were likely to produce eczematoid changes. His experience corroborated that of other observers, that ointments were often of limited usefulness in the tropics because they caused maceration of the epithelium.

Healing of granulations and ulcers on the tympanic membrane could often be hastened by applications of 10-percent solution of silver nitrate. Eczematoid changes, which most often were found on the concha and auricle, responded more favorably to continuous wet dressings of 1-percent solution of aluminum subacetate than to other forms of therapy.

Patients with severe otitis externa, with fever and insomnia, were usually treated in the hospital, with moist hot compresses. Sulfonamides and penicillin were given by the acceptable routes. Simonton [34] recommended the

[32] Treatment for Otitis Externa in the Tropics (News and Comment). Bull. U. S. Army M. Dept. 7: 165-167, February 1947.

[33] See footnote 5, p. 418.

[34] See footnote 5, p. 418.

addition of intravenous injections of typhoid vaccine, a single injection usually being sufficient. In his experience, pain had usually disappeared by the time the chill was ended, and patients treated by this regimen were relieved of otitis externa in from 2 to 3 days, against 4 to 7 days when it was omitted. He warned, however, that the method was not without danger, as shown by the development in one case of acute hemolytic jaundice, for which multiple transfusions were required. Particular care had to be taken to secure an adequate output of urine during the period of profuse perspiration which followed the chill.

Streptomycin, Sultamylon, and other agents later used in the treatment of otitis externa were not available during the period of combat in World War II. The realization of the importance of an alteration in the pH of the external auditory canal in the causation of otitis externa is also a postwar development. In retrospect, however, it is possible to say that the best results in this condition in World War II were obtained by the otolaryngologists who put their emphasis upon principles of treatment rather than specific types of therapy and who consciously or not used methods to restore the integrity of the epithelium of the external auditory canal, with a pH toward the acid side.

Otitis Media

Installation after installation, both in the Zone of Interior and overseas, reported that the treatment of chronic discharging ears was a constant problem, and some otolaryngologists stated that the volume of outpatients was sometimes so great as to interfere with the care of inpatients. The problem arose primarily because men were inducted with this condition, which tends to be reactivated by exposure to cold, while in combat overseas the effect of shellblast was added to the deleterious effects of climate.

In the Zone of Interior, it was the common practice to arrange for Certificate of Disability discharge for patients with chronic otitis media. In the United Kingdom, the need of manpower usually kept men on active duty unless loss of hearing made transfer to the Zone of Interior necessary. It did not prove wise to send men with otitis media into combat zones. They frequently were of no military value because they had to be started back through the chain of evacuation almost immediately. In evacuation hospitals, it was the usual practice to evacuate patients whose infections did not clear up within a week. Those who recovered within this period were returned to duty.

At the 298th General Hospital in the European Theater of Operations, a study of 100 patients with chronic otitis media was reported by Maj. Joseph Brown Farrior, MC. The study was undertaken to determine the degree and position of the obstruction, by comparison of the pressure required for autoinflation of the middle ear (Valsalva's maneuver) with the pressure required for its inflation through a eustachian catheter. The apparatus used consisted of a mercury manometer connected by one arm of the Y-tube to a pressure

bulb and by the other arm to the nasal tip of the eustachian catheter.

Eighty-one of the hundred patients with otitis media were unable to accomplish autoinflation of the middle ear when the pressure averaged 61.2 mm. Hg, though ordinarily, during the Valsalva maneuver, the middle ear inflates at a pressure of 20 to 40 mm. Hg.

A normal eustachian tube can be inflated through the catheter at a pressure of 2 to 4 mm. Hg. Sixty-one of these hundred patients with otitis media had no evidence of obstruction peripheral to the pharyngeal orifice by this criterion. Fifteen had pressures of 10 mm. Hg or less, indicating mild obstruction at this point, and 24 had pressures greater than 10 mm. Hg, indicating marked obstruction.

As the result of this study, it was concluded that in 75 percent of the patients with chronic otitis media in the Army age group, the predominant obstruction was at the pharyngeal orifice of the eustachian tube, which is the position most accessible to the effects of irradiation applied locally in the nasopharynx.

The use of the sulfonamide drugs in the treatment of otitis media produced widely varying results. At the station hospital, Fort Monmouth, N. J., where they were used routinely in the early stages of the cases of nonsuppurative otitis media which occurred during an epidemic of nasopharyngitis, the failure of development of any additional cases of mastoiditis was attributed to this practice. At almost all installations, in fact, the use of the sulfonamides and penicillin in the early stages of acute suppurative middle-ear disease was regarded as responsible for the very small proportion of subsequent mastoiditis and the small number of mastoid operations necessary. The promiscuous and indiscriminate use of insufflations of sulfanilamide powder was agreed to be both ineffective and harmful.

From the total experience, it seems fair to conclude that both the sulfonamides and penicillin were useful in acute otitis media but that their value was doubtful in acute exacerbations of the chronic disease and that they were of no value at all in the treatment of chronic otitis media. Moreover, their use was not free from risk, partly because of their possible masking effects and possibly because of the false sense of security which they were likely to engender when they were used by inexperienced physicians who concluded that relief of symptoms was synchronous with resolution of infection. There seems little doubt that some acute infections became chronic under these circumstances and that some instances of partial or complete deafness resulted, though the statement represents an impression rather than a fact, since the hearing was seldom tested.

Mastoiditis

Simple mastoid operations were relatively infrequent during World War II, both in the Zone of Interior and overseas. Almost without exception, this was attributed to the prompt and adequate use of sulfonamide drugs and peni-

cillin in acute suppuration of the middle ear. When chemotherapy and antibiotic therapy were adequate and when proper attention was paid to the state of the tonsils, nasopharynx, and sinuses, it was no longer regarded as necessary to operate, dogmatically, at the end of 3 weeks for mastoid disease. If the micro-organisms were not sensitive to the sulfonamide drugs and penicillin, these agents were naturally of no avail.

Inadequate chemotherapy and antibiotic therapy were not only ineffective but actually dangerous. The most severe complications of mastoid infection were observed in such cases, chiefly because the masking effects of these agents produced in the physician a totally unwarranted sense of security.

Sinusitis

Few otolaryngologists dissented from the view that patients with chronic sinusitis should not be sent overseas and preferably should not be inducted. Sinusitis was frequently reactivated by exposure to cold, and the resulting attacks were often acute and severe. In some general and station hospitals, the volume of chronic sinusitis and otitis media requiring treatment in the clinic was large enough to interfere with the care of inpatients. In combat areas, the exacerbation of chronic sinusitis was even more serious, since the patient had to be started back on the chain of evacuation to the communications zone, thus interfering with the care of battle casualties while at the same time being of no use himself in a combat zone.

Simple acute sinusitis was frequently observed in England, where many soldiers seemed to have difficulty in becoming acclimated. Whenever possible, sleeping out-of-doors and in damp tents and quarters was prohibited, in an endeavor to prevent the development of the condition in susceptible subjects. Simple acute sinusitis was also often a complication of epidemics of nasopharyngitis at camps in the Zone of Interior following the arrival of increments of troops fresh from civilian life. The incidence of the condition in the Army would probably have been much higher than it was except for the screening at the induction centers of men known to have serious and recurrent types of disease.

Various methods of nonsurgical therapy were employed in the treatment of sinus disease. There was almost universal agreement that neither chemotherapeutic nor antibiotic agents were effective in chronic sinusitis. On the other hand, in the acute type of disease, when the infecting micro-organisms were sensitive to these agents, the results were frequently good, though they were achieved by the systemic use of sulfanilamide and its derivatives and of penicillin rather than by their local use.

Some hospitals reported good results in a few cases of suppurative sinusitis treated by the injection of 50,000 to 60,000 units of penicillin into the antrum after irrigation with physiologic salt solution, the treatment being repeated every 2 or 3 days. As a rule, only 2 or 3 treatments were necessary. In

evacuation hospitals operating in support of combat divisions, it was not practical to institute time-consuming therapy for sinusitis. The otolaryngologists reported that the most effective treatment in those installations was irrigation, followed by instillations of 5,000 units of penicillin in physiologic salt solution directly into the antrum. The use of this method, in their opinion, greatly decreased the number of irrigations necessary to clear up an acutely infected antrum. Some observers were of the opinion that, if the infection did not clear up under this form of care within a reasonable time, nothing short of radical surgery on the antrum was likely to be of value.

It was frequently observed that while such diseases as empyema of the sinus might be temporarily improved by local penicillin therapy, the condition tended to recur as soon as the antibiotic was withdrawn. Numerous reports indicated that the sulfonamide drugs and penicillin were of great value in the acute fulminating type of sinusitis with thrombophlebitis.

The total experience was that the sulfonamide drugs and penicillin were of great value in preventing the spread of infection to neighboring tissues in acute cases but were of dubious, if any, value in chronic cases. Better results were invariably achieved by their systemic rather than their local use, and their local application became less and less popular as the war progressed. Their possible masking effect had to be borne in mind whenever they were used, and there seems little doubt that in some cases harm was done by their use.

Elective intranasal sinus surgery, particularly ethmoidectomy, was discouraged. It was generally agreed that this was a wise policy since, even after operation, patients with sinus disease seldom made acceptable soldiers. As a rule, if the condition did not clear up under conservative measures and if the disease had existed prior to his induction, the soldier was discharged from the service. Surgery was necessary in the occasional case of acute fulminating sinusitis with perforation of the anterior wall. A modified Lathrop technique usually gave good results with negligible cosmetic destruction. The sulfonamide drugs and penicillin were used before and after operation.

A number of alveolar-antral fistulas were observed following the extraction of teeth and were further complicated by chronic maxillary sinusitis. Closure was seldom successful until the antrum was cleared of diseased membrane and intranasal antrotomy was performed. Good results were usually achieved by the Caldwell-Luc operation, followed by closure of the fistula with a wedge-shaped flap of mucous membrane from the buccal surface of the alveolar process. The flap was left attached above but was undermined to above the buccogingival line after the fistulous tract had been excised and the buccal wall of bone removed.

Dacryocystitis

An occasional case of dacryocystitis was observed, due variously to infection and to the sequelae of accidents. In one instance, the condition was caused by congenital absence of the duct.

Dacryocystitis was usually treated surgically. Goldman [35] reported a technique designed to increase the chance of forming and maintaining a permanent ostium between the lacrimal sac and the nose. It was suitable for use in both the intranasal (Wiener-Sauer or West) and the external (Toti-Mosher) operation.

The procedure was very simple. A silk thread in the eye end of a straight needle was passed through the inferior canaliculus into the nose. It was grasped in the nose and sutured to the end of a rubber catheter. The catheter was pulled through the fistulous opening which had been created, and the thread was fastened on the forehead.

This technique was used successfully in four cases.

Allergy

In a small percentage of cases in the Zone of Interior, symptoms referable to the nose and throat were finally explained on the basis of allergy. The majority of otolaryngologists, however, were impressed by the small number of patients for whom this explanation was possible. Overseas, cases of this sort were somewhat more numerous. Some otolaryngologists in the United Kingdom believed that the greater susceptibility to colds observed in that climate among military personnel might be the result of aggravation of pre-existing perennial hay fever. Others were inclined to attribute the incidence to the system of heating, to which Americans were unaccustomed. In this connection, several observers commented on the fact that convalescence from otolaryngologic conditions was slower in England than in the United States, although precisely the same methods of treatment were used.

Capt. Richard H. Stahl, MC, at the 318th Station Hospital, which functioned both in the Zone of Interior and the European Theater of Operations, commented on the numerous patients who had longstanding complaints referable to the nose, throat, and chest and whose roentgenologic sinus findings were positive, even though diagnostic antral irrigation, as well as intranasal findings, were negative. None of the patients had a previous history of allergy. Although the precise etiology was never determined in these cases, it was concluded that they might represent an allergic and climatic response in individuals subjected to a new environment.

In the Pacific areas, allergy was a more serious consideration. At the 54th General Hospital in the Southwest Pacific, it was believed that 25 percent of all nasal complaints could be explained on the basis of allergy. The reactions to dust, plants, grasses, weeds, molds, and fungi were probably greater under the circumstances of military life than they would have been in a more favorable environment. Some cases could probably be explained on the grounds of physical allergy and could have been treated with histamine or nicotinic acid had

[35] Goldman, J. L.: Rubber Catheter Used to Maintain Patency of Ostium in Dacryocysto-rhinostomy: preliminary report. Arch. Otolaryng. 46: 58-66, July 1947.

these agents been available. Numerous patients who had sinusitis as well as rhinitis did not respond to the measures ordinarily used and sometimes had to be evacuated. An occasional case of vasomotor rhinitis was explained on a neuropsychiatric basis, though a more reasonable explanation was usually an allergic response by a susceptible individual to a new environment. The diagnosis of allergy in many instances was merely presumptive. Materials for testing were insufficient, but even if they had been available there was no time to undertake the elaborate diagnostic routine often required in such cases.

Syphilis

Syphilis, in both the primary and the secondary form, was occasionally seen by the otolaryngologist in the Zone of Interior and overseas. Unexplained cervical lymphadenopathy was sometimes found, after aspiration and dark-field examination, to be of this origin. In the secondary form, a macular rash of the pharynx and larynx, with dysphonia, was the chief clinical finding. Gumma of the tonsil was occasionally observed in German prisoners of war.

Diphtheria

Although diphtheria was seldom observed in the Zone of Interior during World War II, it was of considerable concern to otolaryngologists in the European Theater of Operations (table 4), in which a large number of cases were observed among prisoners of war. The treatment of carriers, in particular, provided serious problems. Numerous instances of acute nasopharyngeal diphtheria, confirmed by smear, culture, and animal inoculation, were observed in United States military personnel in that theater and were extremely serious, because the throat lesions were often not of the typical textbook character and the diagnosis was therefore delayed. The administration of therapeutic antitoxin was sometimes correspondingly delayed for this reason. Some observers were of the opinion that diphtheria in Europe differed from the classical type observed in America, and they raised the question of the wisdom of administering toxin-antitoxin to all overseas units.

The most usual diagnosis in unsuspected cases of diphtheria was Vincent's angina or peritonsillar abscess. Postdiphtheritic paralyses were occasionally observed, paralysis of accommodation being most frequent, though the nasopharynx, pharynx, and larynx were also affected. In a few cases, the diagnosis of diphtheria was not made until after paralysis had occurred. A few instances of cutaneous diphtheria of the nasal septum (confirmed by animal inoculation) were also observed and were sometimes not recognized until perforation had occurred. Further necrosis could usually be prevented by the administration of antitoxin.

In the Pacific, wound infections due to diphtheria were fairly frequent, but diphtheria furnished no particular problem to the otolaryngologist.

TABLE 4.—*Incidence (total cases) of diphtheria in the United States Army: By theater and year, 1942–45*

[Preliminary data based on individual medical record sample tabulations of primary and secondary diagnoses]

[Rate expressed as number of cases per annum per 1,000 average strength]

Theater or area	1942–45		1942		1943		1944		1945	
	Number	Rate	Number	Rate	Number	Rate	Number	Rate	Number	Rate
All theaters and areas	5, 724	0. 22	122	0. 04	569	0. 08	1, 578	0. 20	3, 455	0. 46
Continental United States	619	. 04	67	. 03	205	. 04	152	. 04	195	. 07
Total outside Continental United States [1]	5, 105	. 48	55	. 09	364	. 22	1, 426	. 37	3, 260	. 70
Europe	2, 557	. 58	27	. 33	45	. 17	245	. 15	2, 240	. 94
Mediterranean [2]	1, 087	. 73	2	. 09	197	. 43	628	. 97	260	. 73
Middle East	45	. 31	1	. 17	23	. 43	11	. 24	10	. 24
China-Burma-India	208	. 47	8	. 91	15	. 38	155	. 92	30	. 14
Southwest Pacific	615	. 33	3	. 04	7	. 04	100	. 19	505	. 49
Central and South Pacific	519	. 41	4	. 03	69	. 24	266	. 61	180	. 48
North America [3]	19	. 04	2	. 02	3	. 02	14	. 11	0	
Latin America	23	. 06	5	. 05	2	. 02	1	. 01	15	. 21

[1] Includes admissions on transports.
[2] Includes North Africa.
[3] Includes Alaska and Iceland.

COMBAT-INCURRED INJURIES

General Principles of Management

The Manual of Therapy [36] prepared for use in the European Theater of Operations before D-day included the following instructions for the early management of wounds and injuries of the ear, nose, throat, larynx, and sinuses:

1. *Control of hemorrhage.*—The chief method of control of hemorrhage is the use of bandages applied over gauze pads or rolls. Hemostats and ties are placed on vessels easily available. Bleeding from the external auditory canal, which is usually slight, is checked by the use of sterile gauze or cotton wick; packing is employed only if the loss of blood is serious. A bandage is substituted for packing of the canal whenever this is possible. Nasal bleeding should occasionally be checked by the application of petrolatum-impregnated-gauze packing, placed through the mouth and held in place with a cord through the nose. Pharyngeal hemorrhage, if severe, requires ligation of the external carotid artery or tracheotomy with packing of the wound.

2. *Maintenance of airway.*—Dangerous obstruction of the airway is considered to be present when the respiration of a patient at rest is audible to the observer at a distance of about 3 feet from the patient. Under those circumstances, unless the patient can be watched constantly, tracheotomy is performed if there is notable progression of the obstruction within an hour. The rationale of the operation is that laryngeal edema recedes much more rapidly with a tracheotomy tube in place and that patients travel better with an adequate airway.

3. *Preservation of tissue.*—Debridement, in contrast to instructions for other wounds, is not to be performed in wounds of the ear, nose, throat, sinuses, and larynx. Pieces of bone, loose teeth, and every piece of tissue which has any chance of survival are left in situ, for use in later plastic repair.

4. *Syringing.*—Wounds about the face and wounds of the sinuses frequently communicate with the throat, and syringing is therefore avoided because of the possibility of aspirating foreign material into the lower air passages. Syringing is also regarded as contraindicated in wounds of the ear. There is always the possibility of introducing infection into the external auditory canal, and, if there is hemorrhage from this orifice or if cerebrospinal fluid is leaking from it, the loss is usually not serious. The only treatment necessary is the use of a sterile gauze or cotton wick lightly tapped into the canal. Suspected blast injury or rupture of the eardrum is similarly treated.

5. *Evacuation of deafened casualties.*—Sudden deafness, whether unilateral or bilateral, whether partial or complete, occurring after exposure to excessive noise is regarded as the result of injury of the internal ear. If the auditory impairment does not improve in 2 or 3 days, the patient is evacuated for otologic care.

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[36] Manual of Therapy, European Theater of Operations, 5 May 1944.

After a tour of the hospitals in France following D-day, which permitted observation of the management of otolaryngologic casualties, certain alterations were made in the instructions given in the management of these casualties, as follows:

1. Operations for the removal of foreign bodies should not be done in transit hospitals unless removal of the foreign body is necessary for safe evacuation or unless definitive treatment can be provided at the same time. Foreign bodies in the vicinity of the facial nerve are not to be removed unless at the same time a competent surgeon is available to explore the nerve throughout its course in the soft parts and in the mastoid process.

2. Penetrating wounds of the paranasal sinuses should not be operated on unless a qualified otolaryngologist is available to explore the sinus and provide adequate drainage at the same time. Antral drainage into the nose is the method of choice unless the external wound is large enough to permit observation of the antrum for approximately 7 days. Drainage of the frontal sinus through the skin is the method of choice, either through the wound of entrance or by way of an incision permitting drainage through the floor of the sinus.

3. Debridement of facial wounds should include the removal of devitalized soft parts and loose pieces of bone.

4. Wounds of the nasal mucosa should be treated with a view to preventing the formation of synechiae. Gauze packs impregnated with 5-percent sulfadiazine ointment are useful to prevent adhesions, but removal of portions of the bony or cartilaginous septum may be necessary.

Injuries of the Tonsils

Wounds of the tonsils were not usual. One case was reported at the 227th General Hospital, European Theater of Operations, in which tonsillectomy was necessary for the removal of a large foreign body in the pharynx. The wound of entrance in the neck was small, and the foreign body could be felt below the tonsil; after tonsillectomy, it was easily removed from the muscle of the floor of the fossa.

Injuries of the Pharynx

Injuries of the pharynx were uncommon and were usually incidental to other wounds. In the occasional neck wound, the pharynx was laid open and had to be closed by sutures.

Injuries of the Larynx

Penetrating and perforating wounds of the neck and lower jaw frequently involved the larynx and were primarily otolaryngologic problems. Under these circumstances, tracheotomy was frequently a lifesaving measure. It was the policy to perform it in field hospitals in any doubtful case. It was

often done in cases in which it would not have been required in civil life; this was necessary because of the distance of the patient from the fixed installation in which he would receive further treatment. If the procedure had been merely a prophylactic one, the tube was usually removed promptly, and closure was likely to occur without complications. Wounds of the larynx frequently required extensive plastic surgery. In some cases in which considerable distortion and deformity had occurred, it was possible to excise scar tissue by indirect laryngoscopy at repeated operations. Paralysis of the vocal cords was sometimes the result of injury to the recurrent laryngeal nerve.

Injuries of the Auricle

Wounds of the auricle were uncommon. As a rule, they healed without complications, though an occasional case of facial paralysis resulted. In the repair of such wounds, emphasis was put upon the maintenance of wide, clear external canals.

Blast Injuries and Rupture of the Tympanic Membrane

Perforation of the tympanic membrane following concussion resulted, for the most part, from detonation of high-explosive shells and bombs. The hearing loss, which was usually accompanied by tinnitus, was likely to be severe. There was, however, no constant relation between the degree of damage to the membrane and the degree of hearing loss. Large perforations were consistent with normal hearing, and the eardrum might show no perforation when there was severe damage to the hearing apparatus. Some otologists believed that in such cases the labyrinth was involved. Others considered that the impact following blast was transmitted directly to the cochlea through the bones of the skull and was not to be explained by a conductive mechanism. Patients with blast injury who were seen early sometimes presented marked hyperemia with hemorrhages into the tympanic membrane.

Various methods of treatment were employed. Insufflations of powdered sulfanilamide into the external auditory canal or, if the perforation were large enough, into the middle ear were at first thought to be useful, but most otologists later came to doubt their value and to consider them actually harmful. Local instillations of penicillin through a eustachian catheter gave good results in some cases in which acute purulent otitis media followed the tympanic rupture, but in other instances neither the local nor the systemic use of penicillin was satisfactory.

Cellophane was used to close the perforation in numerous cases, with varying degrees of success. The general impression was that it was not as efficacious for this purpose as Cargile's membrane because of its apparently increased tendency to "walk" from the membrane to the s[illegible] of the external auditory canal. Cigarette paper was used in one insta[illegible]. The paper

was picked up with an applicator tightly wound with cotton moistened with sterile salt solution and was wiped onto the perforation, the edges of which were then cauterized by the application of trichloroacetic acid. In other installations, cauterization by this agent was carried out if healing had not occurred within 3 or 4 weeks after the injury.

As the war progressed, the opinion became general that the best results were achieved in cases which had not been tampered with and that a discharge was likely to occur if any medication was employed. When the outer half of the auditory canal was cleansed of dirt and foreign matter and was lightly plugged with sterile cotton, the perforation usually healed quickly, and infection did not occur. Some otologists came to believe that even simple cleansing measures were not indicated and might be actually harmful.

It was observed at one station hospital in the Zone of Interior that practically every patient with a perforation of the tympanic membrane gave a history of being near a charge which had detonated while he was covering the length of an infiltration course. When this situation was realized, the policy was adopted of calling an otologist in consultation for every patient who was admitted to the hospital as the result of explosions of mines and shells. Many cases of perforated eardrums were thus detected, interference with them was prevented, and in most instances healing occurred promptly and without complications.

Many patients with deafness resulting from blast injury regained their hearing promptly, without treatment, though tinnitus might continue to be severe. Hearing which had not improved by the end of the sixth week after injury was unlikely to improve, and the patient had to be referred to an aural-rehabilitation center.

The therapy of tinnitus was frequently unsatisfactory. If it persisted after the improvement of hearing, psychotherapy was often useful. Vitamin therapy, Prostigmin, inflation of the eustachian tube, and all other methods proved far less useful. The patients were instructed not to try to escape or repel the noises but to study them and to become interested in their intermissions, changing pitch, and other characteristics. Nervous strain was promptly relieved in patients who could follow this advice, and the symptom came to be evaluated as little more than a harmless annoyance.

Injuries of the Mastoid

Penetrating wounds through the mastoid cortex were not common. In all such wounds, early definitive surgery was performed, whether the cause was a fracture or a foreign body and whether or not the facial nerve was involved. It was particularly important that foreign bodies be promptly removed, preferably in the communications zone. It was equally important, on the other hand, that such explorations should not be undertaken until a surgeon was available who could explore the facial nerve throughout its source at the same

time, though not all mastoid injuries were associated with injuries of the facial nerve. At the 9th Evacuation Hospital, which functioned in both the North African and European theaters, the facial nerve was involved in only 2 of 11 wounds in which the foreign body lay within the cellular mastoid tissue; in 1 of these 2 cases, the injury to the facial nerve was apparently within the parotid gland, which was traversed by the bullet. Two cases of complete facial paralysis were observed by Maj. John E. Scarff, MC, both due to penetration and exenteration of the mastoid by bullets which made their exit slightly in front of the ear. Both patients were left with total deafness on the injured side, though their vestibular symptoms gradually subsided.

Injuries of the Sinuses

Very little combat experience was needed to make clear the following points about the management of wounds of the paranasal sinuses:

1. Exploration of every penetrating wound of the sinuses was necessary, the more prompt the better. In a surprising number of cases, bullets entering the skull at various points traversed the sinuses, particularly the antra and the nasal septum, without injuries to vital structures, but this could never be taken for granted.

2. Foreign bodies, debris, and bone fragments should be removed promptly and thoroughly, at the earliest possible stage in the chain of evacuation. The presence of a competent otolaryngologist was, however, essential. If he were not available in a forward area, it was better to delay the operation. Observation at hospitals in the communications zone showed a marked difference in the condition of the patients when radical debridement had been performed and when it had been omitted, regardless of which sinus was affected. Foreign bodies, if not too large, could sometimes be removed by the intranasal route.

3. The supradental incision was frequently a useful method of approach, though, in many wounds of the maxillary sinus, debridement could be performed through the wound of the cheek.

4. The institution of early, adequate intranasal drainage was essential in all penetrating injuries of the sinuses.

5. Crushing injuries of the frontal sinuses were originally treated by complete ablation, a deforming procedure which usually required subsequent plastic restoration. An attempt was always made to preserve the normal anatomy of the sinus by preservation of as much of the bony structures and soft tissues as was compatible with adequate debridement. Success in this endeavor depended upon the following points: (1) Careful debridement; (2) preservation of all viable bone spicules and the periosteum for final closure and approximation; (3) no ablation of the sinus if more than half of the mucous membrane was in position; (4) no interference with the nasofrontal duct, drainage never being employed; (5) thorough cleansing of the sinuses; (6) restoration of the normal contours of the sinus and maintenance of the position

of fragments by suture of the periosteum, preferably by nails or wiring, to maintain the contour of the supraorbital ridge and alinement of the frontal process of the zygomatic bone; (7) covering of the dural perforation with fascia lata grafts; (8) closure of the wound with a small subcutaneous drain, to be kept in place for 48 hours; and (9) adequate postoperative chemotherapy and antibiotic therapy.

In severe comminuted fractures of the antrum, gratifying results were frequently obtained by reduction through the Caldwell-Luc approach, preservation of all viable fragments, and maintenance of a slightly overcorrected position for 3 or 4 days by plain gauze packs brought out through a large window in the inferior meatus. If herniation of the orbital contents had occurred into the roof of the antrum, the gauze pack, frequently containing penicillin or one of the sulfonamide drugs, was left in position longer.

Alveolar-antral fistulas following wounds were more difficult to close than those following tooth extraction [illegible] because of the dense, avascular tissue likely to surround them. [illegible] ...ps, however well mobilized, did not heal satisfactorily, and it was usually necessary to use large palatal flaps.

By the middle of 1944, sufficient quantities of penicillin were available to permit its use in all cases in which it was indicated. Controlled observations in numerous hospitals made it clear that this agent, like the sulfonamides, was not a substitute for sound surgical procedures. In wounds of the face with damage to the paranasal sinuses, surgical debridement with drainage of the sinuses remained the most important consideration in the management of every case. A localized abscess cavity required evacuation of the contents. Foreign bodies had to be removed. Devitalized bone and soft tissue had to be excised. If the blood supply to the affected area had been damaged, the value of systemic antibiotic therapy and chemotherapy was correspondingly reduced. Failure to clear the sinuses of debris often did not prevent the healing of skin wounds, but later suppuration and distortion, which interfered with normal emptying, were likely to occur. Following the use of penicillin or the sulfonamides, the patients would seem to be in good condition when they were evacuated, but in reality they harbored potentialities of later trouble. The number of these complications eventually became so large that, in the European theater, the Chief Surgeon issued urgent instructions to be certain of the state of the interior of any paranasal sinus when the radiograph showed increased density, regardless of the clinical condition of the patient. Patients from whose sinuses foreign bodies were not removed (chiefly because the objects were not radiopaque and adequate exploration was therefore not done) almost invariably developed future sinus trouble, regardless of the immediate good results.

Injuries of the Nose

The protruding position of the nose accounted for its frequent injury by direct blows. When the trauma was not accompanied by marked loss of tissue

or severe injury to the maxillary bones, to the eyes, or to the frontal sinuses, a nasal fracture could be reduced easily, quickly, and satisfactorily by a simple method which could be applied by the first medical officer to see the injured man. The services of a specialist were not required, and roentgenologic examination was superfluous. The diagnosis could be made by visual inspection and manipulation, and the position of the replaced bone was determined merely by a knowledge of its ordinary position in relation to the other features of the face.

The blow causing the damage was frequently followed by sufficient numbness of the tissues to make the use of any anesthesia unnecessary. As the procedure required but a few seconds, the patient was merely warned that there might be pain during the period of manipulation. Cocaine was never used intranasally because of the risk of rapid absorption through the lacerated mucosa. General anesthesia was best avoided because of the possibility of aspiration of blood in the pharynx. The manipulation could be performed under regional procaine analgesia, but the time consumed did not justify its use unless the pain was extremely severe or unless repair of extensive skin lacerations was also required. Bleeding from the skin or from the nasal mucosa was fairly frequent, but, even if it did not cease spontaneously, manipulation of the bones and cartilage was proceeded with before attempts were made to check it.

A rigid instrument, such as a straight hemostat, a periosteal elevator, or, best of all, a nasal bayonet forceps was wrapped with cotton, to protect the mucosa from further laceration. The instrument selected was of a size to permit easy entry into the nasal cavity. The cotton-wrapped instrument was introduced into the cavity on the side from which the blow had occurred, and its end was directed toward the glabella or into the lower part of the nasal cavity, where it was rotated to lie parallel with the dorsum of the nose. The whole instrument was then lifted outward with one hand while with the other the nose was molded externally until a proper shape was obtained. At the conclusion of the procedure, packing was applied to stop whatever hemorrhage might have occurred and to hold the bones in place. A single piece of petrolatum-impregnated gauze, packed rather tightly, was placed in each nasal cavity. The edema which occurred in such injuries held the bones and cartilages in place so that external splints were not necessary. As a precautionary measure against possible further trauma, a piece of dental molding was sometimes placed over the dorsum of the nose, but it had to be applied with great care to avoid pressure points on the skin and a subsequent undesirable scar. After the bony framework of the nose was replaced, lacerations of the skin were carefully approximated. Bone fragments were removed only if they were completely detached from both skin and mucosa.

The packing was gradually removed over the next 2 or 3 days. Fractures treated in this manner usually healed without complications.

If replacement had been delayed longer than 6 hours, edema associated

with the nasal fracture usually kept the bones and cartilage in malposition and it was difficult or impossible to replace them by the maneuver described. Cosmetic deformities and mucosal synechiae frequently resulted. Interference with normal nasal physiology, as the result of structural alterations, usually required the services of both the rhinologist and the plastic surgeon at a later date. At this time, however, it was very difficult and often quite impossible to secure a good result.

In severe depressed fractures of the bridge of the nose associated with dislocation of the septal cartilage, poor reduction was usually the result of failure to elevate the impacted frontal process of the maxilla and to maintain elevation. This type of fracture dislocation provided one of the few instances of nasal fracture in which head traction was necessary; a hairpin splint was used, with one arm under the bridge of the nose. The maintenance of forward traction prevented the development of saddlenose.

At the 74th General Hospital in the European Theater of Operations, a simple and satisfactory method of preparing a plastic appliance for immobilization of fracture deformities of the nose was worked out. Black dental wax was heated in water and then rolled into a very thin sheet. This wax sheet was modeled over the nose and frontal bone, the displaced parts being held in position by pressure of the fingers while an assistant hardened the wax by flushing it with cold water. An acrylic splint was made from this model by the dental laboratory. Two precautions were essential with this method: (1) The wax had to be rolled into a very thin sheet, so that the proper position could be determined under it before it was hardened; and (2) the splint had to be modeled over the frontal bone as well as over the nasal bone. If the latter precaution was omitted, the splint was likely to be useless.

In all wounds involving the nasal mucosa, petrolatum-impregnated packs or packs impregnated with 5-percent sulfadiazine ointment were used to prevent the formation of synechiae. If they had already formed when the patient was first seen, they were incised, or, if necessary, portions of the bony or cartilaginous septum were removed. Methods were then instituted to keep them from re-forming.

Maxillofacial Injuries

The Manual of Therapy pointed out that if a correlated plan of treatment was carried out in maxillofacial injuries from the time the wound was incurred until definitive treatment became available, the period of disability would be greatly shortened and a larger number of patients would be restored to approximately normal function and appearance than if haphazard methods of treatment were followed.

The important points in the early management of these injuries were listed as follows:

1. *Control of hemorrhage.*- As far as possible, hemorrhage was controlled by pressure from gauze compresses and bandages. Hemorrhage which could

not be controlled by these simple measures required the use of clamps and ligature of the bleeding vessels. In severe hemorrhage, digital pressure was applied to the bleeding vessel at a control point in its course until a clamp and ligature could be applied.

2. *Maintenance of an adequate airway.* The mouth and throat were cleared of fragments of teeth, fragments of bone, broken or dislodged dentures, and other foreign matter. Compresses and bandages were so applied as not to increase respiratory difficulty. In fractures of the mandible, particular care was taken not to create backward pressure or traction distally by bandages. If the airway seemed insufficient, it was improved whenever possible by the insertion of a rubber tube through the nose or mouth to the nasal pharynx. An intratracheal tube was sometimes used. Tracheotomy was done promptly if simpler measures failed to provide an adequate airway. In cases of massive injury about the jaw and pharynx, this frequently proved a lifesaving measure.

In cases of collapse of the pharynx and floor of the mouth or of loss of control of the tongue, the airway was maintained by holding the tongue forward. It could be held in place temporarily by the use of a safety pin or a suture.

Fractures of the superior maxilla frequently displaced loose structures downward and backward and definitely interfered with respiration. Bilateral comminuted fractures of the posterior part of the mandible sometimes caused the chin segment to drop downward and backward, also causing respiratory difficulties. In either of these situations, the front of the jaw could be held forward by a simple emergency splint. It was constructed and applied as follows: Two wooden tongue depressors were placed end to end and held in this position by two other overlapping depressors, all being fastened together with adhesive tape. A circular bandage was bound about the head, and the splint was incorporated in it, the upper end being attached to the bandage in the occipital region with a piece of tape and the lower end being projected in front of the mouth. A wire ligature was attached to the lower teeth or was passed around the chin segment of the mandible, and the ends were fastened to the lower end of the splint either directly or with a rubber band. This splint effectively held the anterior end of the mandible forward. In cases of backward displacement of the maxilla, forward traction could be similarly attained by attachment of the upper teeth to the apparatus.

3. *Temporary approximate reduction and fixation of maxillofacial fractures.* The wound was cleansed superficially, fragments of teeth, detached bones, and other foreign matter being removed. Displaced parts were adjusted to their anatomic position and were held in place by gauze compresses and bandages. Care was taken to avoid collapsing bone segments and to prevent backward traction on the mandible. Fractures of the maxilla and of the adjacent facial bones were gently stabilized by bandaging. In primary treatment, stabilization was improved by the application of gauze compresses and bandages used to control hemorrhage. All bandages were applied with the idea of reestablishing the original occlusion of the teeth. Wire ligatures and

suture material, if available, were applied to the teeth of the injured jaw across the line of fracture to assist in stabilization of parts during evacuation. Multiple loop wiring, with intermaxillary elastic traction for reduction and stabilization of fractures, was accomplished if time and facilities permitted. Rigid intermaxillary fixation with wire was definitely contraindicated as primary treatment for patients to be evacuated, for fear they would become nauseated or that respiratory interference would develop during evacuation. Edentulous patients required bandages to support the parts and prevent the collapse of segments.

4. *Other measures.*— Adequate measures for the relief of pain and the prevention of shock were instituted in patients with maxillofacial wounds, but morphine was administered with the greatest caution, if at all, to patients in respiratory difficulty. It was contraindicated if cranial injuries were associated with the maxillofacial wounds. Ambulant or semiambulant patients with oral or pharyngeal wounds always traveled sitting up if that were possible. The patients evacuated on litters were placed in a comfortable position face down, so that there would be no possibility of interference with the airway or of any aspiration of fluid.

Gastrostomy was occasionally performed in fractures of the mandible but was not regarded as indicated in the usual case.

Dentures, even if broken, were always transferred with the patient, for use in adjusting and splinting of the alveolar parts.

Although wounds of the face were handled on the general principle of performing adequate debridement, including removal of loose pieces of bone, the debridement was made no more extensive than was absolutely necessary, so that loss of tissue would be minimal. It was frequently observed at base hospitals that the most impressive evidence of the value of debridement was furnished by the poor condition of the patients in whom it was omitted or in whom it was inadequately done. In these cases, which fortunately were few, infection was likely to have progressed to such a degree that definitive surgery had to be deferred for considerable periods of time and the end results of plastic surgery were likely to be jeopardized.

Wounds in which skin grafting was not necessary were closed as promptly as possible by secondary suture. When healing was slow, various methods were used to encourage granulation, including soaks of weak azochloramine solution and petrolatum-impregnated-gauze dressings.

Otolaryngologists and maxillofacial and dental surgeons cooperated in the management of maxillofacial injuries, particularly compound and depressed fractures of the maxilla in which intranasal drainage under the inferior turbinate was usually required. The dental surgeon wired all fractures of the mandible, maxilla, and other bones, and then made wax impressions from which acrylic splints were constructed in the dental laboratory. Fractures of the malar bone were reduced most efficiently by the Gillies open method. Fractures of the superior maxilla and zygoma usually remained in alinement after they had

been reduced by some approved procedure, elaborate head traction seldom being necessary. The supradental approach was useful when fragments had been driven into the antrum. Early evacuation to the Zone of Interior was recommended for patients with maxillofacial defects of considerable extent, but it was not always possible to carry out the policy promptly.

Osteomyelitis was sometimes persistent after fracture of the mandible. Penicillin was used parenterally and locally, and sequestrectomy, curettage, and fixation were employed as necessary.

ANESTHESIA

Anesthetic methods in otolaryngology in World War II varied, within permitted limits, according to individual preferences. Pentothal Sodium (thiopental sodium) anesthesia was seldom used in procedures on the throat and nose, in which it may be extremely dangerous. Local analgesia by infiltration and block was highly satisfactory. Wide blocking of the maxillary and mandibular nerves, and sometimes of the anterior and posterior ethmoid nerves, was practiced. Endotracheal anesthesia, which at first was used tentatively, proved extremely satisfactory in radical operations on the antrum and mastoid and was occasionally used for tonsillectomy. Tonsillectomy was seldom done under general anesthesia.

ENDOSCOPY

Bronchoscopy served important diagnostic and therapeutic purposes and was an essential part of the otolaryngologist's function in general hospitals. It was performed almost routinely after the removal of foreign bodies from the lung and after the repair of penetrating and perforating wounds of the chest, while the patient was still in the operating room. Bronchoscopic removal of accumulated secretions from the bronchi proved a useful prophylactic measure against postoperative atelectasis. Bronchoscopy was carried out in cases of atelectasis, as soon as the diagnosis was made, and was also performed on the usual indications for the removal of foreign bodies from the bronchi.

Diagnostic esophagoscopy was useful in gunshot wounds of the throat and upper chest, in which damage to the esophagus was suspected, and in suspected esophageal malignancy. An occasional foreign body was removed by this method.

Laryngoscopy was used under the same circumstances as in civilian practice. It was useful in the diagnosis of laryngeal tumors. It permitted biopsy in doubtful cases, and small tumors could be removed by this method.

AUDITORY IMPAIRMENT

The inadequacy of hearing tests used at induction centers (p. 453) accounted for the induction into the Army of a considerable number of men with defective

hearing. In numerous instances, the men were aware of their auditory impairment. In other instances, the realization of the impairment gradually came upon them because they failed to hear commands or had difficulty in hearing normal conversational voices. Numerous otolaryngologists called attention to the type of defective hearing which occurred insidiously, without other signs and symptoms referable to the ear, and which was apparently due to eustachian salpingitis associated with disease of the nose and nasopharynx. This type of auditory impairment was observed rather often in England. It frequently did not respond to radon therapy applied for hypertrophy of the lymphoid tissue of the nasopharynx. In some instances, it was believed to be entirely due to climatic conditions, and patients in this group were returned to the Zone of Interior to prevent further hearing loss.

The usual policy in both the European and the Pacific theaters was to evacuate soldiers whose loss of hearing was beyond the serviceable degree. Those whose hearing loss was sufficient to make them a menace to themselves and to their companions in combat were sent to replacement depots for reassignment to noncombat units.

Because living conditions in the United Kingdom Base were generally good, many of the same policies applicable to service troops in the United States could be applied to service troops stationed there. The Theater Surgeon therefore agreed to the issue of electric hearing aids to key personnel, and, after the policy had proved practical, to any soldier whose hearing was sufficiently depressed to affect the performance of his duties. This policy was in accord with the conservation of manpower urged by Army authorities but was naturally applied only to personnel who were psychologically adaptable and who were performing useful duties of a kind with which the use of a hearing aid would not interfere.

The first issue consisted of Western Electric aids, which were fitted in the London office of the company, where individually fitted earpieces were also made. Of the first 36 aids issued, 3 were returned, 1 because it was no longer needed and the other 2 because the loss of hearing was merely borderline and the aid was of insufficient value to warrant its use. In the remaining cases, the men who were wearing the aids reported greatly improved hearing.

The success of the initial test led to an extension of the program. It was estimated that perhaps three-quarters of all persons with auditory impairment could wear the Zenith type of aid, and an order for 500 was therefore sent to the Zone of Interior, the plan being that they would be issued by experienced otologists in certain designated hospitals. Through a misunderstanding, the order was not filled for several months, and as a result of this and other circumstances, the aids were not received in the United Kingdom until the middle of December 1944. Additional reasons for delay in distribution were difficulties in training personnel to distribute the aids and the slow transfer of men who were to receive them to installations in which their hearing could be properly evaluated and the aids issued. The battery problem also presented certain

difficulties. Distribution of the aids was therefore deferred until 1 March 1945. Between that date and 1 July 1945, approximately 200 hearing aids were issued, and 75 percent of the men who wore them, as determined by a later followup survey, expressed themselves as well satisfied with them.

In spite of the limited application of the program and the difficulties and delays experienced in setting it up, it was believed that, through it, men who would otherwise have been lost to the Army in that theater were enabled to remain on duty and to function efficiently.

It had been planned to study the use of aids by recently deafened soldiers, to determine whether the period of deafness caused by battle trauma could thus be shortened. For many reasons, including anxiety on the part of the patients, the frequently rapid recovery of function, and necessary transfers from one hospital to another in which aids were not items of issue, this part of the program was not carried out.

CHAPTER III

The Aural-Rehabilitation Program for the Deafened and Hard of Hearing

Leslie E. Morrissett, M. D.

HISTORICAL NOTE [1]

During World War I, rehabilitation of Army personnel with hearing defects was under the direction of the otolaryngological section of General Hospital No. 11, Cape May, N. J. The chief agency in the program was the school of lipreading, which was operated for a little over a year by 11 teachers, all experts in the field.

According to the plan set up for deafened casualties, any soldier who could not hear a conversational voice at a distance of 5 feet in the better ear was assigned to the school, and instruction was begun without further formalities. Meantime, such otolaryngologic treatment as might be necessary was instituted. Instruction was continued until the soldier reached a level of ability as a lipreader beyond which further improvement did not seem likely. Except for advanced group practice work, all instruction was individual. Classes were held in small individual rooms, without distractions of any sort, 2 or 3 times daily, sometimes for 30-minute periods but more often for 45-minute periods. Instructors were changed at intervals to train the pupil to read different lips. Both the schedule and the content of the course were adapted to the capacity of the individual pupil.

It was estimated that during World War I, total aural disability occurred once in every 5,000 casualties and partial disability at least 4 times as often. In October 1943, the Veterans' Administration had on its compensation or pension rolls 416 totally deaf veterans of that war and 12,397 partially deafened.[2] How many of these had some form of aural disability before induction into service is not known, but it is suspected that the number was large. Only 108 war-deafened soldiers received instruction in lipreading at the Cape May hospital. Some 400 more who should have had such training were not identified until after their discharge to civil life. In spite of the small number

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[1] The Medical Department of the United States Army in the World War. Washington: Government Printing Office, 1924, vol. XI, pt. 2, sec. V.

[2] Hillman, C. C.: The Army Rehabilitation Program for the Blind and Deafened. J. A. M. A. 125: 321-323, June 1944.

treated, the lipreading program was described by Berry[3] as "one of the bright spots in the Army's reconstruction activities." The same author presented the following statistics for the school:

The average age of the 108 deafened soldiers was 26 years. While the majority were of the laboring class and 27 were completely illiterate, 61 had some grammar school training, 16 had gone through high school, and 4 were college trained. Ninety-three percent had been in service overseas. The degree of deafness was as follows: 32 were totally deaf, 13 could hear only a "shout" near the ear, and 24 could hear more than a "shout" but less than "conversation" at 1 foot. Of these patients, 52 had become suddenly deaf and 56 progressively deaf. Two showed an added hysterical form of deafness. In the severe cases, deafness was of the nerve or perception type, with meningitis the most usual cause. In the less severe cases, deafness was of the conduction type, of catarrhal or suppurative origin.

A definite relationship existed between the original ability of the soldier to understand parts of what was said and the time he required to complete the course. A few learned all that was necessary in 6 weeks, but most patients required an average of just over 3 months to complete the course. The illiterate man learned as readily as the college graduate, and the amount of deafness did not seem to influence the final lipreading ability.

Berry summed up the work at Cape May in these words:

> The remarkably short time needed to acquire the art of lipreading is ascribed to three factors: (1) the intensive nature of the work (two or three lessons daily), (2) the individual lessons, and (3) the enthusiasm and persuasiveness of the highly skilled teachers. The men were saturated with lipreading, in an optimistic environment of devoted service. The nearer one can approach such an intensive program and such an environment, the better will be the results.

THE EARLY PHASE OF AURAL REHABILITATION IN WORLD WAR II[4]

The potential importance of the problem of the deafened soldier was realized early in World War II, and, on 28 May 1943, the realization took practical form in the designation of specialized centers for the treatment of personnel with "defective hearing of a degree which precludes the return of the patient to duty."[5] These centers were established at Borden General Hospital, Chickasha, Okla.; Hoff General Hospital, Santa Barbara, Calif.; and Walter Reed General Hospital, Washington, D. C. Since the hearing center

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[3] Berry, G.: Reeducation of the Deafened Soldier. *In* Ophthalmology and Otolaryngology. Military Surgical Manuals. Prepared and edited by the Subcommittees on Ophthalmology and Otolaryngology of the Committee on Surgery of the Division of Medical Sciences of the National Research Council. Philadelphia: W. B. Saunders Co., 1942, p. 257 ff.

[4] Unless otherwise specified, the World War II aural-rehabilitation material is derived from the histories of the Army Aural-Rehabilitation Centers for the Deafened and Hard of Hearing at Borden General Hospital, Deshon General Hospital, and Hoff General Hospital.

[5] War Department Memorandum No. W40-14-43, 28 May 1943, subject: General Hospitals Designated for Special Surgical Treatment.

at Walter Reed General Hospital was exceptionally busy with routine work, Deshon General Hospital, Butler, Pa., was later designated in its place as a specialized center for the treatment of deafened casualties.[6] The actual transfer (of 20 patients) was effected 1 November 1943.[7]

Statement of policy. The first phase of the aural-rehabilitation program was under the direction of Maj. (later Lt. Col.) Walter E. Barton, MC, a trained psychiatrist who was assistant director of the Reconditioning Division, Office of the Surgeon General. The first statement of policy for the new program made the following points:[8]

1. Deafness (like blindness) is a deprivation of essential normal means of orientation. It produces a profound emotional upset and engenders the need for special rehabilitation measures.

2. The Army, rather than the Veterans' Administration, whose ultimate responsibility the deafened casualty would be, was delegated to do the immediate work of rehabilitation, partly because deafness was often associated with illness or wounds requiring long treatment and partly because the period of rehabilitation could be shortened if immediate treatment was begun.

3. The program was planned to include (1) social and psychiatric treatment to overcome the initial trauma of deafness and its effect on the personality; (2) medical and surgical treatment as necessary; (3) provision of a properly fitted hearing aid "to any soldier whose hearing had been impaired as a result of his military service, where it was felt that some benefit would accrue"; and (4) education for social living, in which the entire personnel of the center was trained to participate and which included a full program of recreational and educational activities in addition to specialized training in lipreading, speech correction, and related fields. The program covered the indoctrination of the soldier's family, instruction of the patient in his rights in regard to pension and disability allowances, and the making of contacts with civilian agencies for the hard of hearing.

The initial statement of policy, the general principles of which were later incorporated in a circular letter,[9] also included instructions on how to secure lipreading and speech-training teachers, acoustic experts, occupational therapists, and social workers, and information regarding their qualifications and duties; instructions for the procurement of equipment and supplies; and a suggested organization chart.

Conference on rehabilitation of the deafened.—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

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[6] Letter, Col. John A. Rogers to Commanding Officer, Deshon General Hospital, 13 Sept. 1943, subject: Rehabilitation of the Hard of Hearing in Army Hospitals.

[7] Annual Report, Reconditioning Division, Office of the Surgeon General, 1943-44.

[8] Letter, The Surgeon General to Commanding Officer, Borden General Hospital, 1 July 1943, subject: Rehabilitation of the Hard of Hearing in Army Hospitals (statement of program enclosed).

[9] Circular Letter No. 162, Office of the Surgeon General, U. S. Army, 11 Sept. 1943, subject: Rehabilitation of the Blind and the Hard of Hearing in Army Hospitals.

was authorized by The Surgeon General and was held at Hoff General Hospital, 2–4 February 1944.[10] Those in attendance included the heads of the otolaryngologic services at each of the specialized centers, the principals of the lipreading schools or instructors from them, the hearing-aid experts at the various centers, and invited guests experienced in work with the deafened. All phases of rehabilitation of the deafened were discussed, including medical problems, organization and administration, facilities, equipment, methods of teaching, contents of courses, acoustic training, fitting of hearing aids, and vocational rehabilitation. The majority of the recommendations made by the conference were put into effect in one way or another when the aural-rehabilitation program was reorganized under the Otolaryngology Branch in the Surgical Consultants Division, Office of the Surgeon General, in June 1944.[11] The most important of these recommendations were that

1. Rehabilitation services for the deaf be independent of otolaryngologic sections.

2. Trained personnel be left undisturbed on the rehabilitation services.

3. Otologists, lipreading teachers, and other personnel be supplied in proportion to patient loads.

4. Hearing aids be furnished to all deafened and hard of hearing in the Army instead of, as at present, only to men with hearing impairment incurred in line of duty.

5. Training in residual hearing, pyschiatric examinations, and vocational rehabilitation be stressed.

6. Certain administrative changes be made, including the appointment of a superintendent of the rehabilitation service at each center, to coordinate the work of the lipreading school and to direct all administrative and nonmedical activities.

REORGANIZATION OF THE PROGRAM OF AURAL REHABILITATION

The mere perusal of the recommendations made by the Conference on Rehabilitation of the Hard of Hearing held at Hoff General Hospital in February 1944 makes clear that up to this time the three specialized centers for rehabilitation of the deafened and hard of hearing were operating practically as individual units. The late Dr. Walter Hughson of the Otologic Research Laboratory, Abington Memorial Hospital, Abington, Pa., civilian consultant in otology, in a report [12] on the hearing center at Deshon General Hospital,

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[10] (1) Program of Conference on Rehabilitation of the Hard of Hearing, Hoff General Hospital, Santa Barbara, Calif., 2–4 Feb. 1944. (2) Memorandum, Maj. Walter E. Barton, MC, for Chief, Professional Services, 13 Mar. 1944, subject: Conference on Rehabilitation of the Hard of Hearing, held at Hoff General Hospital, Santa Barbara, Calif., 2–4 Feb. 1944.

[11] Office Order No. 175, Office of the Surgeon General, U. S. Army, 25 Aug. 1944, subject: New Organization Chart.

[12] Letter, Walter Hughson, M. D., to Brig. Gen. Clark C. Hillman, 16 Feb. 1944, subject: Army Treatment of Deaf Casualties.

16 February 1944, stated that his chief criticism of the current operation of the rehabilitation program was that no uniform plan governed the operation of the three centers. As a scientific otologist, he wrote, he greatly deplored this situation. The implications of a program involving a large and completely controlled number of cases were of the greatest significance for the present and future of civilian as well as of military otology, but the program could not possibly have this value without a completely unified method of examination and recording in all three centers.

In the same communication, Dr. Hughson also called attention to the necessity for the administration of objective tests by qualified personnel to determine the instructional needs, potentialities, and progress of each patient. It was inconceivable, he went on, that a satisfactory remedial program could be planned and executed for any casualty without a preliminary estimate of his mental ability, educational achievement, and general language status. An adequate psychologic understanding was absolutely essential to a sound educational program and as a basis for successful vocational rehabilitation of individual patients. It was also essential that educational aides have the type of background which would enable them to utilize psychologic data in their instruction.

In June 1944,[13] Brig. Gen. Fred W. Rankin, Chief, Surgical Consultants Division, following a visit of inspection to 2 of the 3 hearing centers, reported to The Surgeon General that, although the deafened and hard-of-hearing casualties had to date received excellent care, he regarded it as essential for future progress that (1) the activities of all three centers be made uniform, (2) equipment be standardized, and (3) a standard policy be adopted for the procurement of hearing aids, with complete exclusion of all commercial contacts. To carry out these recommendations, General Rankin recommended that an otologist who would devote his full time to the deaf program be placed on duty in the Surgeon General's Office. In July 1944, Maj. (later Lt. Col.) Leslie E. Morrissett, MC, formerly chief of the eye, ear, nose, and throat service at Borden General Hospital and in charge of the center for the deafened and hard of hearing at that installation, was placed on duty as chief of the newly organized Otolaryngology Branch in the Surgical Consultants Division in the Surgeon General's Office.[14]

REORGANIZED AURAL-REHABILITATION PROGRAM

The first duty of the newly appointed chief of the Otolaryngology Branch was to survey the situation at the three hearing centers. This was accomplished by questionnaires dealing with equipment and methods of procedure

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[13] Memorandum, Brig. Gen. Fred W. Rankin for The Surgeon General, 6 June 1944, subject: Inspection of General Hospitals Designated as Centers for Treatment of the Deafened and the Hard of Hearing.

[14] Personnel Order No. 24, Office of the Surgeon General, U. S. Army, 13 July 1944, subject: Changes in Officer Personnel, SGO.

and by personal visits of inspection. An analysis of the data thus secured made it clear that, as General Rankin had noted,[15] the deafened and hard-of-hearing casualties had received excellent care and that the chief deficiencies of the program at this time had to do with (1) lack of equipment, which was being procured and installed as rapidly as possible; (2) shortages of personnel; and (3) lack of uniformity in organization and procedure.

By the new plan of operation put into effect in all three centers (fig. 4), Lt. Col. Norvil A. Martin, MC, Maj. (later Lt. Col.) Edward H. Truex, MC, and Maj. Walter P. Work, MC, directed the aural-rehabilitation program at Hoff General, Deshon General, and Borden General Hospitals, respectively. Their assistants were responsible under their direction for the diagnostic and therapeutic supervision and management of the patients. Those in charge of the various levels of instruction and other activities supervised, under higher direction, the personnel and program on their respective levels.

The object of the reorganization was fourfold: (1) To integrate the activities of the programs at the three hearing centers; (2) to accomplish as much as possible by medical and surgical treatment for casualties with auditory impairment; (3) to supply better care for such casualties than they could receive when each center operated as a special unit; and (4) to simplify the machinery of consultation, when medical and surgical consultation should be

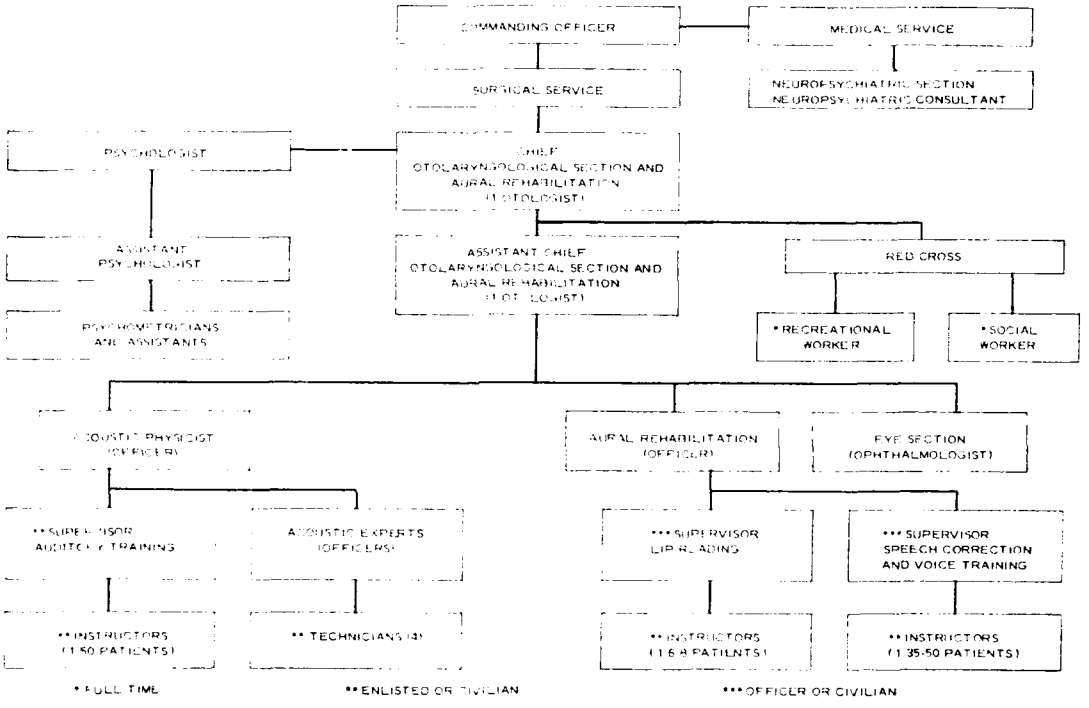


FIGURE 4.—Organizational structure at specialized centers for the treatment of the deafened and hard of hearing.

[15] See footnote 12, p. 451.

needed, by placing the program under otologic direction rather than operating it as a group of separate services.

The program included diagnosis; medical and surgical care; psychiatric analysis; adequate fitting of the hearing aid best adapted to the particular case; and training in lipreading, speech, and auditory ability. Uniform records were provided, with a separate file for each patient. Bimonthly reports were to be sent to the chief of the Otolaryngology Branch in the Office of the Surgeon General and were to include all pertinent data in regard to the current program, as well as comments and suggestions for its improvement.

Although compliance with the basic organization was insisted upon in every center, the program was permitted to be sufficiently elastic for the expression of individual initiative at each center. Facilities for the transmission of information on all points from each center to the consultant in otolaryngology and for its transmission from him to each of the other centers insured the rapid utilization, for all patients, of any plan or procedure which had proved of value in a single center.

Facilities

As the patient load increased in each of the centers, the problems of expansion of facilities became serious. At the Deshon center, for instance, the initial calculations were for a patient load of 250. Before facilities for this load had been approved, the load was 400. By the time facilities for 400 *patients had been* provided, the load was 500. When the census in this center reached its peak, in August 1945 (fig. 5), it was necessary to schedule activities at night as well as during the day, to permit the fullest utilization of the available facilities. The patients did not suffer, except through the loss of the intimate and personal contact with their physicians and instructors particularly desirable in a program of this sort. Had the load been sustained, however, a break in operational efficiency would undoubtedly have occurred, which would have caused a prolongation of the hospital stay or the creation of a backlog of patients on furlough status.

Selection of Patients

All Army personnel inducted into service in World War II were originally required to meet the standards of physical examination set up in Army Regulations No. 40–105,[16] 29 May 1923, which applied to enlisted men and officers of the Regular Army, the National Guard, and the Organized Reserves. These regulations required acuity of hearing of at least 15/20 in one ear and of 20/20 in the other for enlisted men and applicants for commissions in the National Guard, as well as for service in the Organized Reserves. Applicants for commissions in the Regular Army were required to have hearing of 20/20 in each ear.

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[16] Army Regulations No. 40-105, 29 May 1923, subject: Medical Department. Standards of Physical Examination for Entrance into the Regular Army, National Guard, and Organized Reserves.

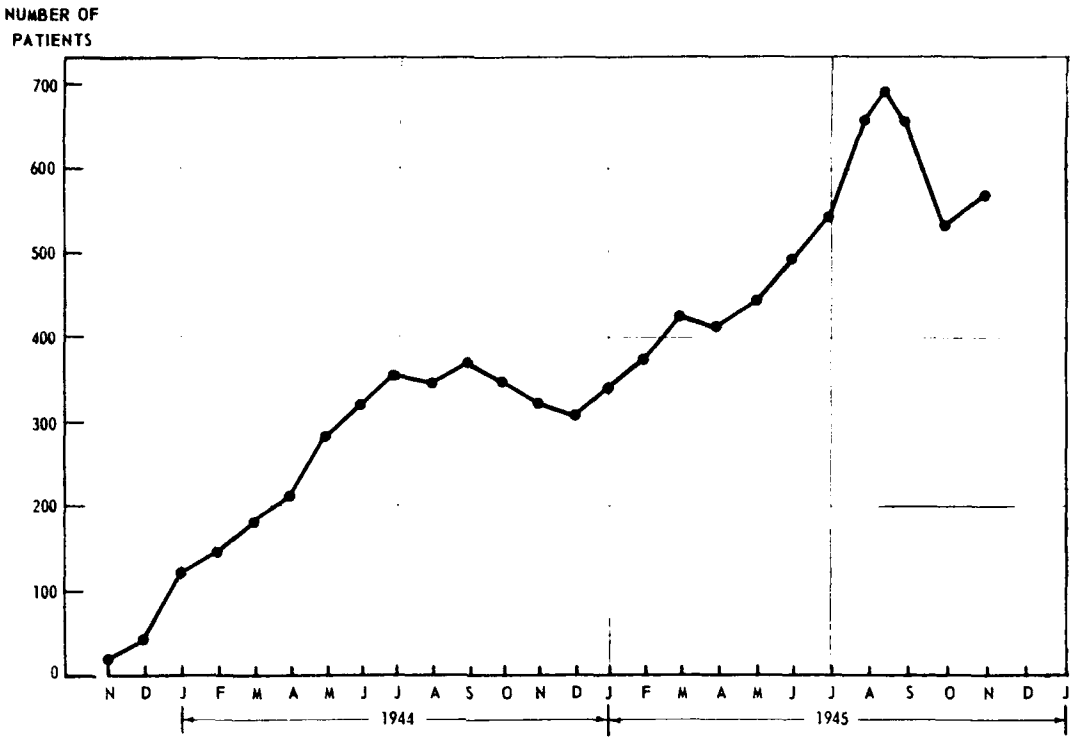


FIGURE 5.—Monthly census of patients, Aural-Rehabilitation Center, Deshon General Hospital.

These regulations were superseded 15 March 1942 by Mobilization Regulations No. 1–9.[17] This regulation applied only to enlisted men in all categories and required, for general service, that hearing be (1) 10/20 or better in each ear, (2) 5/20 in one ear and 15/20 in the other, or (3) 0/20 in one and 20/20 in the other. Induction for limited service was permitted if the hearing in one or both ears was less than 10/20 but not less than 5/20 or if the applicant was completely deaf in one ear but had hearing of not less than 10/20 in the other.

The same requirements were continued in the regulations dated 15 October 1942, but in those dated 22 January 1943 hearing of 8/15 or better was required in each ear. Applicants for limited service were accepted with hearing in one or both ears of less than 8/15 but not less than 5/15 in either ear, or with total loss of hearing in one ear if the hearing in the other was not less than 15/15. The regulations dated 19 April 1944 provided for hearing of 8/15 or better in each ear or of 15/15 in one ear and less than 8/15 in the other. At this time, no defects in hearing warranted initial classification for limited service.

The standards of hearing acuity under which men were inducted into service obviously permitted the entrance of many with markedly defective hearing. The tests by which acuity was determined were admittedly inaccurate

[17] Mobilization Regulations No. 1-9, 15 Mar. 1942, subject: Standards of Physical Examination During Mobilization. These were successively modified 15 October 1942, 22 January 1943, and 19 April 1944.

in themselves, and the circumstances under which they were given, in crowded and noisy induction centers, militated further against their reliability. Whether the substitution of the whisper for the low conversational-voice test in April 1944 improved the situation is perhaps open to doubt. The advantage of the whispered test as compared with the spoken test is that the former has a fairly definite ceiling, though for all practical purposes, when an examiner forces a whisper (which of course he should not do), he reaches a sound intensity not far from that of a low conversational voice. A loud or forced whisper and a low conversational voice both show a sound intensity of approximately 50 decibels at a distance of 4 feet. The whispered-voice test is thus not far from the base line which experience has established as practical hearing. The difference between the whisper test at 15 feet and the lower conversational-voice test at 20 feet is not as great as it seems, because in a free field the intensity of sound varies inversely with the square of the distance.

At the beginning of the aural-rehabilitation program, the stipulation that military personnel with "defective hearing of a degree which precludes the return of the patient to duty" be referred to hearing centers was interpreted as a hearing loss of 60 decibels, which, as the late Dr. Hughson [18] pointed out, was "entirely improper and unjust." At the January 1944 meeting of the subcommittee on otolaryngology of the Division of Medical Sciences of the National Research Council,[19] it was recommended that cases showing an average loss of 30 decibels in the better ear for the frequency of 256, 512, 1024, and 2048 be considered in need of a survey at one of the Army special centers, provided that they have no remedial defects. Thereafter, deafened and hard-of-hearing casualties were referred to the special centers on this basis.

Routine of Rehabilitation [20]

With minor variations permissible under the master plan, the routine of rehabilitation was eventually standardized at each of the hearing centers substantially as follows:

1. The patient was admitted to one of the medical wards reserved for this purpose. Here, a complete history was taken, and a complete physical examination was made by the ward officer. Routine laboratory studies (urinalysis, blood count, and serologic testing) were carried out. Roentgenologic examination of the mastoid region was made in all cases, and other examinations, particularly of the chest, were made on special indications. Consultations were requested as necessary with the surgical, neuropsychiatric, dental, and other sections. Ophthalmologic examination was part of the regular routine.

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[18] See footnote 12, p. 450.

[19] Letter, Lt. Col. M. R. Mobley to Brig. Gen. Clark C. Hellman, 26 Jan. 1944, subject: Admission to Army Centers for Rehabilitation of the Deafened and Hard of Hearing.

[20] War Department Technical Bulletin, TB MED 105, 18 Aug. 1945, subject: The Army's Aural Rehabilitation Program for the Deafened.

A complete otolaryngologic study was made, including a detailed history and physical examination; tests of ossicular mobility; tests of vestibular function; determination of the patency of the eustachian tubes; tests of hearing, including fork tests and complete air-conduction and bone-conduction audiometry; other special tests as indicated.

Audiometric testing was carried out by a strictly prescribed routine, the instructions to the examiner specifying (1) the environment, which was always a soundproofed room (fig. 6); (2) the seating of the patient in relation to the instrument; (3) the preliminary questioning of the patient and detailed explanation to him of his part in the testing; (4) the attachment and operation of the audiometer, which varied according to the model employed; and (5) the recording of results.

Upon the conclusion of the routine just described, a diagnosis was made of the type of hearing loss and the etiologic basis. If the patient's disability did not fall within the prescribed limits for treatment, he was dismissed from the center. If it did, he was referred to the rehabilitation officer and admitted to the rehabilitation course.

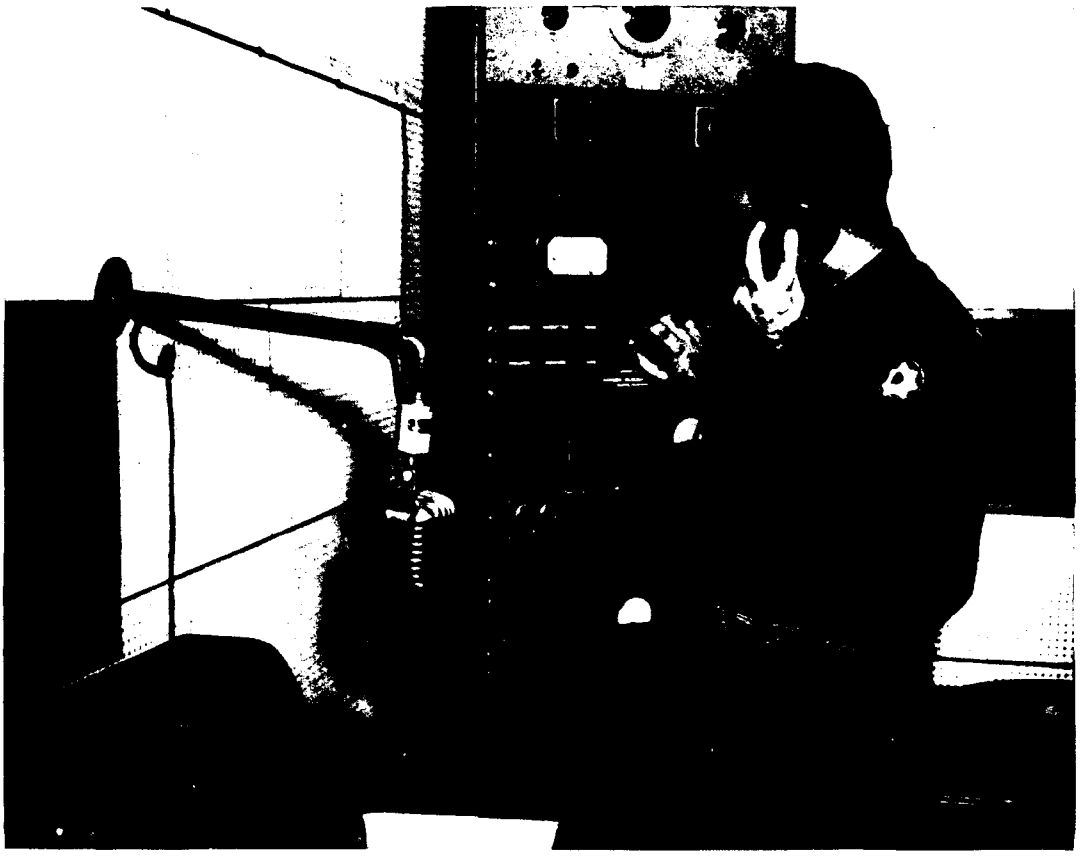


FIGURE 6.—Soundproofed room with electroacoustic equipment, Aural-Rehabilitation Center, Borden General Hospital.

2. Initial testing in the rehabilitation course consisted of (1) repetition of air-conduction and bone-conduction audiometric testing; (2) tests of auditory ability, including monaural distance ratios for spoken- and whispered-voice recognition, binaural percentages of phoniatric discrimination, and binaural distance thresholds for perception of connected speech; (3) tests of visual identification of word and sentence meanings to determine lipreading ability; (4) systematic speech sound articulation inventory and voice check; (5) psychologic testing, including intelligence, special aptitudes, and personality composition; and (6) social case history.

3. Upon completion of these procedures, patients not actually in need of hospital care for aural or other reasons were transferred to the convalescent unit, where they were assigned such duties as would be performed by any other ambulatory patient, kitchen police being no exception. Physical exercise, under supervision, occupied at least an hour daily, and provision was made for both indoor and outdoor recreation. Daily, weekend, and extended (3 day, one a month) passes were encouraged, ordinary social contacts being regarded as the most practical possible method of having the soldier put into practice the abilities in which he was being trained.

The great majority of the patients required no otolaryngologic treatment, though an occasional case of sinus disease would be observed and occasional tonsillectomies and still more occasional mastoidectomies were performed. After operation of the centers became standardized, otologists assigned to the aural-rehabilitation units performed only minor surgical procedures, and otolaryngologists not connected with the aural-rehabilitation program handled all major procedures. Very few patients presented sufficient lymphoid tissue in or about the orifice of the eustachian tubes, with enough pathologic change in the tubes or the middle ears, to warrant transfer to a radiation center for treatment.

The data secured by the tests listed were recorded on appropriate forms, reviewed by the aural-rehabilitation officer and then discussed by a consultation board, which met weekly. This board consisted of the director of rehabilitation, the aural-rehabilitation officer, the ward officers, and the supervisors of each department. At the conclusion of the discussion, a course of study was outlined for each patient according to his particular needs and abilities. The preliminary evaluation was regarded as essential to intelligent planning, because the wide variation in the intelligence and in the intellectual, educational, and social backgrounds of the patients made individualization of the course extremely important.

A study of certain data at the Hoff center, which can be assumed to be representative of all centers, showed that the age range of the patients was 18 to 58 years, that the average age was 29, and that two-thirds of the population of the center fell within the 22- to 32-year age group; 0.8 percent of the patients were illiterate and were taught to read and write in the course of rehabilitation; 7.2 percent were college graduates; 8.6 percent were commissioned officers and

31.6 percent noncommissioned officers; and 5.4 percent had previously followed professional and 53.2 percent unskilled occupations. The hearing disability had been present only a few months in 15 percent of the patients, less than 4 years in 35 percent, over 4 years in 65 percent, and over 12 years in 31 percent.

COURSE OF STUDY

Lipreading. This course included training in sounds, words, sentences, conversation, lectures, and moving pictures. The material, which was largely original, was adapted to the educational background and the occupations and interests of the patients, who eventually contributed most of it by themselves. Two books of original material, based for the most part upon individual ex-



FIGURE 7.—Deafened casualty receiving instruction in lipreading, Aural-Rehabilitation Center, Borden General Hospital. The wall chart shows the V-position assumed by the mouth in the pronunciation of vowels. The WAC instructor was an instructor in a school for the deaf in civilian life.

periences, were developed at the Hoff center, A Framework of Instruction in Lip Reading, and Tales of Hoffmen. Instruction stressed the importance of taking advantage not only of the movement of the speaker's lips (fig. 7) but also of the facial expression and of other visual clues to the purport of what was being said.

Auditory training.—This course, which was begun as soon as possible after the patient's admission to the center, was at first carried on without the hearing aid and later, when it had been secured, with it. It included individual and group conversations against a background of silence and of various noises. From conversation, the students progressed to lectures, music, radio, moving pictures, telephone conversations, and natural sounds. Material was presented at gradually increasing distances. Whatever the method employed, the purpose of the course was the same - to train the patient to listen attentively, so that he would employ as fully as possible the residual hearing and the hearing available to him through his hearing aid.

Voice training and speech correction. Recommendations for voice training and speech correction were based on observation of individual defects as determined by words, conversation, and reading selections; all tests were related to the patient's intellectual abilities, which had previously been determined. The course included instruction in ear training; tongue, lip, and jaw gymnastics; breath control; sound analysis with relation to special defects; and drills on corrected speech habits. Attention was paid to pitch, timing, and loudness and quality of the voice, as well as to articulation.

An analysis of the material at the Deshon center showed that the course in speech training was necessary in only a limited number of cases. Thirty percent of the patients had obvious speech abnormalities, but many of them were of the social and economic strata in which the abnormalities could be completely disregarded. In other instances, the abnormalities were purely dialectical. In all, not more than 10 percent of all patients presented abnormalities of speech which could reasonably be related to their auditory impairment.

Special apparatus, particularly the mirrophone, was of great assistance in the courses in voice training and speech correction. In every case, an initial and a final recording of the voice was made.

Speech insurance. A course in speech insurance was given at each center to every patient with a severe hearing loss to guard against speech deterioration in the future. As a general rule, the course was given only to patients in whom deterioration, in the absence of measures taken to prevent it, might be expected to occur, but it was sometimes found desirable to give it to patients who were taking speech correction. As in the speech-correction course, attention was paid to pitch and quality and loudness of the voice as well as to articulation, though the teaching approach in each course was necessarily different.

SOCIAL SERVICES AND VOCATIONAL COUNSELING

The American Red Cross assigned to the aural-rehabilitation program well-trained and interested workers whose activities were coordinated by visits from the executive secretary of the American Society for the Hard of Hearing, on temporary loan to the American Red Cross. Shortly after a patient was admitted to a hearing center, he was interviewed by the Red Cross worker who explained to him the various services offered by the Red Cross and made such contacts with his family, through the local Red Cross chapter, as seemed necessary and desirable. Casework services were supplied during the period of hospitalization. The patient was encouraged to bring his problems to the worker, and difficulties which developed in any of the training courses were referred to her.

If the patient was discharged from service, the Red Cross worker assisted him in completing his application for a pension and wrote to the local Red Cross chapter, which made contact with the local Veterans' Administration office, or to the State vocational service, as necessary. A final letter was sometimes written to the family.

Each center carried out a program of physical education and recreation under the reconditioning officers assigned, and every provision was made for both supervised and unsupervised recreation. Certain wards in each center were equipped with amplifier units for the hospital radio, and the chapel, recreation hall, and moving-picture theater were similarly equipped, as were certain of the telephones. Tickets were supplied for plays, concerts, football games, and other community entertainment. The Volta Review, Hearing News, and books of special interest to the hard of hearing were added to the usual library books and journals.

At the end of its first year of operation, the Hoff center held a lipreading tournament which aroused a great deal of interest and enthusiasm. The 2 teams of 6 patients each which participated made final scores of 81 and 89, respectively. The contest was held in the officers' club and was attended by the commanding officer and a large number of officers, enlisted personnel, and patients not connected with the aural-rehabilitation program.

Patients were encouraged to participate in the occupational-therapy programs at the centers as well as in the educational programs offered, though admission to the latter naturally depended upon their previous educational background. The better educated and more intelligent patients frequently assisted in the details of the aural-rehabilitation program. Other patients worked in the branch post exchanges, the supply and orderly rooms, and the library. Still others worked in the special-services section or served as chaplains' assistants. Through the cooperation of local service organizations, some patients, in the time allowed for unsupervised recreation, were trained in auto mechanics, watch repairing, cleaning and pressing, creamery management, and similar useful occupations.

The hearing center at Hoff General Hospital conducted an 8-hour driver-training program in the sixth week of each course, consisting of 3 lecture periods on safety education and road rules, 2 hours of tests and 3 hours of instruction behind the wheel of a car. The primary objective of the course was to teach the deafened patient to depend upon his eyes to compensate for his loss of hearing. The secondary objective, which applied to not more than 3 percent of the group, was to teach driving to those who did not already know how to drive a car. At the conclusion of this course, tests were conducted, and licenses were given by the California State Department of Motor Vehicles.

The purpose of the entire recreational and occupational program was to provide each patient with all possible opportunities to keep himself occupied at all times. Recreation was encouraged, but emphasis was also placed, directly and indirectly, upon useful occupations, with the realization that the "disintegrating" effects of idleness are perhaps the most serious obstacle which any disabled man must overcome.

FINAL EVALUATION AND DISPOSITION OF PATIENTS

During the eighth week of the rehabilitation program, or sooner if the patient's level of achievement warranted it, the aural-rehabilitation officer again interviewed the patient and personally evaluated his progress. The director of the program, after he had studied the record, then interviewed the patient and made his own evaluation to determine the need (1) for further hospitalization, for medical or other reasons; (2) for further participation in the rehabilitation program; or (3) for processing for disposition, according to the Army directives effective at the particular time.

Students in the lipreading course were graded as excellent (capable of making an intelligent response to any situation requiring the understanding of speech); good or above average (showing a high degree of mastery of everyday speech); average (possessing a working ability to understand speech with occasional repetitions in ordinary circumstances); and below average (possessing some knowledge of lipreading, which might or might not be useful). There was often a curious difference between the instructors' evaluation of the students' ability and the students' estimate of their own progress. At the Hoff center, in one survey, a third of the patients were rated by the instructors as excellent, about two-fifths as good or average, and the remainder as below average; at the same time, only 1 percent of the students graded themselves as excellent and only 10 percent as above average. Sixty-four percent, however, believed the course to be of great value.

Approximately 9,500 deaf and hard-of-hearing soldiers were treated in the three aural-rehabilitation centers during their approximately 3 years of operation. Disposition [21] of these patients followed a somewhat similar

[21] For a followup study of 261 of the deafened and hard-of-hearing patients treated at Deshon General Hospital, see appendix F, p. 573.

pattern. The following statistical data on the 3,663 patients seen on the aural-rehabilitation service, Deshon General Hospital, 1 November 1943 to 30 April 1946, is representative of the type of disposition made:

Type of disposition	*Number*
Certificate of Disability (enlisted men)	2,202
Military duty	849
Retirement, medical (officers)	311
Transferred to other hospitals for condition other than deafness	143
Transferred to other wards for condition other than deafness	148
Deceased	3
Misassigned	7

PROVISION OF HEARING AIDS

The provision of hearing aids proved to be one of the most difficult phases of the aural-rehabilitation program. The original War Department policy, promulgated 27 August 1943,[22] was to furnish aids only to:

> * * * military personnel suffering from service-connected hearing defects that preclude the performance of military duty, when examination shows that such aids will materially improve the hearing of the individuals concerned and when—(a) Hospitalization for an extended period is necessary before discharge can be accomplished, or (b) It is desired to retain the individual in a limited service capacity.

All such cases were to be reported to the Office of the Surgeon General for consideration of transfer to a hospital designated for treatment of impaired hearing, and the fitting of hearing aids was restricted to these specialized centers unless the patient, for exceptional reasons, could not be transferred to one of them. Repairs and additional batteries for aids furnished to individuals in active military service were properly chargeable to the Medical Department, just as other medical supplies were charged to it.

Personnel not covered by this provision, who were discharged from service with impaired hearing incurred in line of duty, were to be referred to the appropriate Veterans' Administration office for determination of their eligibility for hearing aids. Those suffering from auditory defects which had not been incurred in line of duty and which precluded the performance of military duty were to be discharged on Certificate of Disability or brought before a retiring board. Those not eligible for veterans' benefits were instructed to apply for assistance to the appropriate State vocational rehabilitation bureau. Officers of the Regular Army or of the Army of the United States who were drawing retirement pay were specifically excluded from provision of hearing aids at Government expense.

The distinction in the Line-of-Duty-Yes and Line-of-Duty-No disability naturally resulted in considerable ill feeling on the part of Line-of-Duty-No

[22] War Department Circular No. 192 (VD), 27 Aug. 1943, subject: Hearing Aids for Military Personnel.

men. They were aware, in most instances, that the methods of screening used in induction centers were crude, and they did not hesitate to express resentment of the fact that they were not given aids, particularly if their impairment had been (or if they believed that it had been) aggravated by service.

The original War Department policy concerning hearing aids was changed 23 February 1944,[23] when it was directed that aids be furnished to all personnel in active military service who were suffering from hearing defects, regardless of line-of-duty status, if the defect precluded the performance of military duty and if examination showed that the use of an aid would materially improve the hearing.

The chaotic situation which had existed in respect to the fitting and procurement of hearing aids in the early phase of the aural-rehabilitation program was altered in two ways when the program was reorganized in July 1944: (1) By the development of scientific tests to determine the special aid suited to the needs of the individual patient (figs. 8 and 9); and (2) by the complete separation of the patient from any contact with representatives of the manufacturers of the aids. All aids employed in testing were on the recommended list of the Council on Physical Medicine of the American Medical Association. After November 1944, the lucite eartip for the aid (figs. 10 and 11)



FIGURE 8. Operator running test tones through loudspeaker to deafened casualty in adjacent soundproofed room.

[23] War Department Circular No. 81, 23 Feb. 1944 subject: Hearing Aids—Military Personnel.

was made in the dental laboratories of the hospitals at which the centers were located, with great savings in time and money. Still later, indefinite quantity contracts were closed for the purchase of the aids found on survey to be most frequently used, great savings being effected by this plan in view of the numbers required. The original plan of purchasing aids locally as they were needed had always been recognized as uneconomical, but until adequate data were at hand it was also recognized as a necessity. Under the new plan, it was still possible to purchase aids not covered by the contract, if they were found more suitable for special patients. Testing of new models put out by all manufacturers was continued, regardless of the contract status of the company, so that the savings effected by the contracts in no wise militated against the continued initiative of any commercial concern.

In general, an air-conduction receiver was always fitted unless the patient had a chronic suppurative process or unless bone conduction, as measured by the audiometer, was good, and air-conduction testing indicated poor correction with an air-conduction receiver.

If the patient presented an approximately equal, uniform, bilateral, moderate loss, the ear not used for telephone conversations was fitted. If the



FIGURE 9.—View from room shown in figure 8. Patient, in soundproofed room, is listening to test tones with use of hearing aid. The microphone suspended from the ceiling transmits his voice back to the operator (shown in fig. 8) who records the results.



poorer ear had a loss of less than approximately 70 decibels in the speech range, the poorer ear was fitted; otherwise the better ear was fitted.

The acoustic officer or a qualified assistant, following study of the audiogram and other special tests, plotted 6 or 7 possible fittings for each patient. Each fitting was arranged in turn on the patient who, following careful previous instructions, adjusted the volume while selected sentences were read to him at constant distances. At the Deshon center, a speech discrimination test was conducted in advance of the fitting of the aid, and a screening period preceded the regular fittings; the technician tried a number of aids, in various combinations of models, and ran brief preliminary tests to determine which instruments and which combinations were suitable for further testing. Binaural free field audiometric testing was carried out at the Hoff and Borden centers.

At all three centers, careful tests were conducted to determine speech-articulation thresholds. These tests were followed by determination of the tolerance threshold and the preference level. As a final step, the aid was turned on in full volume to determine the reserve amplification possible with the instrument. The patient was encouraged to express his opinion on clarity, naturalness, quietness of reception, and other features of the instrument being tested, but leading questions were avoided and, except at the Deshon center,

he was kept unaware of his own share in the selection of the aid. At that center, the patient wore each instrument under consideration for final selection for a 24-hour period and also, at a listening hour, indicated on a scale its performance for speech, music, and noises.

The patient was carefully instructed in the method of using the instrument finally selected on the basis of the recorded results of all tests. At first, it was necessary to remind him constantly of the necessity of adjusting the volume



FIGURE 11. Exacto earlip for hearing aid under construction in dental laboratory.

and tone control, according to the circumstances of listening; later, these adjustments became automatic. At the end of a week of wearing, if the instrument did not prove satisfactory, additional instruments were tested. During the period of testing, the patient reported regularly to the acoustic technician or to a designated teacher of auditory training, for necessary adjustments. When he received the instrument, he was given printed instructions concerning its care, and in the first weeks of its use he received further individual and group instruction concerning its proper care, including daily rotation of the batteries and methods of securing the fullest possible aid from it. When he left the center, he was given a month's supply of batteries.

NARCOSYNTHESIS

One of the outstanding developments of the aural-rehabilitation program was the management of cases of psychogenic deafness (p. 473) which in some instances was also associated with true organic damage. Narcosynthesis was tried in these cases because of the excellent results of the method as applied to war neuroses by Col. Roy R. Grinker, MC, during the North African campaign.

Patients were selected most carefully, and treatment was carried out under the joint direction of the otologist, the psychiatrist, and the psychologist. Individual and group suggestion was practiced before narcosis with thiopental sodium was undertaken. Narcosis was light and very carefully controlled. During the period of narcosis, the patient was asked simple questions and was repeatedly assured that he would recover his hearing. The assurances were continued for an hour or two after narcosis was discontinued.

Audiometric and spoken- and whispered-voice tests were recorded as soon as possible after treatment, the tests being carried out by a technician who had been specially trained for the work by a psychologist, and were repeated as often as necessary on successive days to determine the threshold of hearing. Recorded speech-perception tests were run if there was any question of the results of the live-voice tests.

Psychologic evaluation was an important part of the cure. It has been estimated that about 15 percent of the cases of deafness treated in the Army centers were of the hysterical or psychogenic variety, the group including numerous cases in which the disability was of long standing. The results of narcosynthesis were remarkably good.

PRACTICAL CONSIDERATIONS OF THE AURAL-REHABILITATION PROGRAM

It should be emphasized that the problem with which the Army found itself confronted in the rehabilitation of the deafened and hard-of-hearing soldier had no precise parallel in civilian life, either in its magnitude or, in some instances, in the circumstances under which the loss of hearing developed. Surprisingly, however, the number of abruptly deafened soldiers, whether from blast or from head injuries, was considerably smaller than had been anticipated, while the large numbers of casualties expected from the Army Air Forces simply did not materialize. Studies of blast injuries suggest that about two-thirds of the men thus injured suffered no permanent impairment of hearing, while only a small minority of the remaining third suffered sufficient hearing loss in both ears to require rehabilitation and a hearing aid. About 60 percent of the cases of psychogenic deafness, however, were of combat origin. It is of interest that while meningitis accounted for about 25 percent of the deafened casualties of World War I, the number from this cause in World War II was negligible, undoubtedly because of the remarkable effectiveness of chemotherapy in control of the disease.

There was, of course, nothing in common between the rehabilitative problems of the deafened soldier and the problems presented by civilians who were either born deaf or who had lost their hearing before they learned to speak. The deafened and hard-of-hearing soldier, whether he lost his hearing suddenly or whose previously impaired hearing was still further impaired during his military service, suffered his disability after his language patterns were established. Material to teach adults who presented such disparity of social, intellectual, and educational backgrounds for the most part did not exist, and its improvisation was one of the chief tasks of the early days of the program.

In addition to making available suitable teaching material, there existed, at the institution of the program, the difficult task of procuring qualified personnel and highly specialized equipment necessary for the conduct of aural-rehabilitation activities. Trained personnel were completely lacking for speech instruction and auditory training, as were personnel trained in acoustic physics to build, install, and maintain the electroacoustic equipment essential in the program. The procurement of such personnel was accomplished in a variety of ways. All organizations working in the field were solicited for names of qualified personnel. The Adjutant General's files were reviewed to identify Army personnel with such training. Qualifications of WAC's in service were studied, and a WAC recruitment program was instituted for training for this special purpose. The New Developments Branch of the War Department and the National Roster of the War Manpower Commission were also investigated. Advertisements were placed in appropriate magazines to attract teachers through civil service. Finally, a procurement objective for acoustic and rehabilitation officers for the deafened was authorized by The Adjutant General in June 1944.[24]

The retention and proper assignment of the specialized personnel proved no simple matter. It was found, on early visits to medical installations, that otologists specially trained for the aural-rehabilitation program were sometimes being assigned to other duties in which their specialized skills were not fully utilized or were not utilized at all. The importance of retaining intact the organization which had been set up was explained in all service commands, and the time, effort, and expense expended in the training of these officers was emphasized. Eventually, in February 1945,[25] a War Department memorandum directed attention to the importance of retaining critically needed specialists in their special capacities and listed among such specialized personnel psychiatric social workers, lipreading specialists, speech correctionists, and acoustic technicians.

The task of procuring the highly specialized equipment needed for the aural-rehabilitation program presented greater difficulties and for a long time hampered the effective development of the program. Specially constructed

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[24] Letter, The Adjutant General to The Surgeon General, 28 June 1944, subject: Procurement Objective for the Medical Corps, Army of the United States (Medical Administrative Corps).

[25] War Department Memorandum No. 615-45, 2 Feb. 1945, Critically Needed Specialists.

acoustic buildings with calibrated, soundproofed rooms were required to house the electroacoustic apparatus used in the measurement of hearing, and it was not until the fall of 1944 that the major portion necessary was secured and installed in the three centers. Part of the delay was due to shortages of materials, part to limitations of manufacture, and part to the needs and claims of other agencies, chiefly the Signal Corps, Ordnance, and the Office of War Information. In July 1944, all three centers were still without such basic items as sound-level meters and magnetic tape recorders, but by November of that year most of the essential equipment had been installed in all centers and was in operation under a standard, uniform plan directed from the Office of the Surgeon General.

A very wholesome aspect of the Army's aural-rehabilitation program was its perfectly realistic approach to the whole problem of loss of hearing. There was complete realization, as Hughson [26] expressed it, that the "psychologic implications" of deafness are probably "more important than any which will develop as the result of a physical disability," as well as complete realization that in many instances it would be difficult, if not impossible, to disentangle the psychologic threads, so to speak, and to separate the trauma imposed by deafness from the mental and spiritual trauma inherent in the sights and sounds of combat. On the other hand, the utmost care was taken to see that a deafened casualty who was not a psychiatric problem when he entered the center did not become one through overemphasis on such matters.

A special effort was always made to make clear to each patient precisely what he could expect from the rehabilitation course. It was explained unequivocally that a completely deafened or a seriously deafened person could not expect to regain his full hearing but that he could be taught methods of compensating for his disability. It was emphasized that nothing could be accomplished without his own full cooperation, and it was only in the exceptional case that such cooperation was not given. In fact, the psychologists and psychiatrists who participated in the program often commented on the lack of resentment expressed by these patients in respect to their handicap, in contrast to the resentment frequently felt by civilians under the same circumstances, and on their excellent adjustment. Those in charge of the program were quite convinced that this attitude on the part of the patients was in large part the result of the realistic attitude of the staffs of the centers, which was that, in serious auditory impairments, lipreading, hearing aids, and other measures even at the best compensate only partially and that social, vocational, and economic readjustments may be necessary to solve the problems of any individual patient.

Another reason for the normal and well-adjusted attitude of most of the deafened and hard-of-hearing patients was their prompt removal from the hospital atmosphere. The great majority required no otolaryngologic treatment. A few presented sufficient lymphoid tissue in or about the orifice of the

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[26] See footnote 12, p. 450.

eustachian tubes, with enough tubal and middle-ear disease, to warrant transfer to a radiation center for treatment, and an occasional sinus operation and tonsillectomy, and a still more occasional mastoidectomy, were performed.

Most of the patients, however, were not ill, and, when their preliminary testing was completed, they were promptly transferred to convalescent units, where they lived as normal lives as can be lived by men still under military control. At the Hoff center, the circumstances were particularly propitious, for the patients were housed in a well-converted public-school building, several hundred feet above the ocean, in a stimulating and beautiful environment. Although at the Borden and Deshon centers the barracks used for the convalescent units were temporary buildings, equipped with army bunks, few of the anticipated complaints about the discomfort of the arrangements were heard. The men apparently appreciated the social contacts, liberal passes, and other privileges which could not have been permitted under the regimentation and discipline essential in hospital wards, and the contacts, in turn, proved an important phase of their rehabilitation.

A particular attempt was made to explain to the patients that hearing aids, at least in their present state of development, have a limited usefulness. The tendency of the lay public to compare them with glasses, usually to their detriment, is unfortunate; a lens corrects an error in refraction, while the best of hearing aids merely amplifies sounds. It was fully realized by the staff that the fitting of the aids, in spite of every endeavor to select them objectively, was still largely a trial-and-error performance. In this connection, it is of interest that Davis and his coworkers [27] at the Psycho-Acoustic and Electro-Acoustic Laboratories of Harvard University concluded, as the result of exhaustive studies, that objective tests then in use for the fitting of hearing aids were too arbitrary, too elaborate, or too inconclusive to be made the basis of a general routine procedure. Their criticisms were at least disinterested, since several of them had personally helped to develop some of the tests depreciated. Nor can there be any quarrel with the future objectives they set, which were as follows:

1. That objective tests be simplified and designed to insure accuracy in essentials rather than to try to discover a uniqueness of fit which rarely if ever exists.

2. That both tests and routine be designed to identify any special problem or unusual feature of the individual case which might require special or unusual procedures.

3. That the medical and psychologic aspects of the problem, including the indoctrination and training of the patient, be kept in mind at all times.

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[27] Davis, H.; Hudgins, C. V.; Marquis, R. J.; Nichols, R. H., Jr.; Peterson, G. E.; Ross, D. A.; and Stevens, S. S.: The Selection of Hearing Aids. Part II. Laryngoscope 56: 135–163, April 1946.

SUMMARY AND CONCLUSIONS

Although there was nothing new about the problems of patients who are deafened and hard of hearing, the number of such impairments observed in the United States Army and the responsibility assumed by the Medical Department for them permitted a study of the whole field of deafness never possible in civilian life. Many of the accumulated data confirmed previous impressions, many of which can now be regarded as facts. Many of the data are inconclusive, though they point the way to further fields of study.

The integration of the program was perhaps its most significant aspect. For the first time, there were put under a single roof, in large-scale collaboration, all of those concerned with the problem of the deafened and hard-of-hearing patient, including the otolaryngologist specially trained in otology, the acoustic engineer, the teacher of lipreading, the teacher of auditory training, the speech correctionist, and the social worker. Every member of the staff was a specialist in his own field. Some teachers were themselves as handicapped as their pupils and were vital and inspiring illustrations of how handicaps can be overcome. Each center was provided with the best and most modern equipment. Every phase of the program was carefully planned, with the object of making it as intensive and at the same time as streamlined as possible.

Although the Army program of aural rehabilitation was evolved for military purposes, a large part of it has proved applicable to the problem of civilian deafness. It would have been a great waste of effort if the knowledge and experience thus gained had not been transferred. A program which involves the integration of trained personnel, clinics, laboratories, electroacoustic equipment, and classrooms under a single roof is an ideal setup for a community attack upon a local program, though, naturally, the program must be modified to meet practical local considerations.

It should be emphasized, however, that in the application of the military program to civilian circumstances, two principles remain fundamental, that auditory impairment is primarily a medical problem and that an otologist must always be in overall charge of the plan.

CHAPTER IV

Narcosynthesis in the Management of Functional Deafness

Moe Bergman, D. Ed.

The concept of psychogenic deafness was not first introduced during World War II. Otologists had long suspected the existence of this type of auditory impairment and had been concerned about its therapy, but, until accurate methods of diagnosis became available, therapeutic methods were necessarily empirical and were frequently based on little more than guesswork.

Soon after activation of the aural-rehabilitation center for the deafened and hard of hearing at Hoff General Hospital, Santa Barbara, Calif., 6 September 1943, staff otologists became aware of the high incidence of bilateral deafness of possible psychogenic origin among the soldiers admitted for therapy. Numerous diagnostic procedures were employed to confirm the suspicion, but the results were unreliable until, in February 1945, a staff member who had learned of the unusual results achieved in the treatment of war neuroses in North Africa by Lt. Col. Roy R. Grinker [1] suggested narcosynthesis as a technique for both evaluation and therapy in suspected functional deafness. The method proved so effective in the first case in which it was tried that it was recommended as standard operating procedure for all similar cases. Insufficient personnel, equipment, and space unfortunately limited the use of the method to 102 patients. The experience was sufficient, however, to demonstrate that narcosynthesis is as valuable from the diagnostic as from the therapeutic standpoint and to indicate that it should be as useful in civilian practice as it proved to be in military otology.

Between the date of its activation, 6 September 1943, and the date of deactivation, 8 November 1945, 1,375 deafened and hard-of-hearing patients were treated at Hoff General Hospital. Approximately 84 percent of these patients suffered from organic ear disease or from organic deafness with a significant functional overlay. A functional basis was suspected in most of the remaining cases but for various reasons could be established in not quite half.

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[1] Grinker, R. R., and Spiegel, J. P.: Narcosynthesis; Psychotherapeutic Method for Acute War Neuroses. Air Surgeon's Bull. 1: 1-5, February 1944.

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DEFINITIONS AND DISTRIBUTION OF CASES

A discussion of psychogenic deafness necessarily begins with a definition of certain commonly used terms:

Organic deafness is the type which results entirely from nonfunctional causes. Of the 1,375 cases of impaired hearing treated at the Hoff aural-rehabilitation center, 1,156 fell into this category. Since the classification of cases was on a subjective basis, this category undoubtedly contains some cases with an undiscovered functional overlay. The conviction is strengthened by the bizarre results achieved in a few cases classified as organic on the basis of hearing tests made before the introduction of narcosynthesis.

Functional deafness is the type in which there is a demonstrable loss of hearing but in which marked improvement occurs either without therapy or without therapy directed toward the correction of the presumed pathologic process. Ninety-three cases treated at the Hoff center fell into this category. Improvement followed narcotherapy in 76 cases and occurred in the absence of treatment in 17 others.

Questionable deafness is the type in which loss of hearing is probably functional. This group also includes the cases in which there were marked inconsistencies either in the hearing tests or in the patient's history as it related to the ear; these cases were processed before the introduction of narcosynthesis. Cases of suspected functional deafness which could not be treated by narcosynthesis during the later stages of the program, because the patient load suddenly became too great for the specialized personnel available, are arbitrarily included in this category. In all, there were 126 cases of questionable deafness at the Hoff hearing center.

Blast deafness is self-explanatory. Single-blast deafness is the type in which, according to the patient's statement, the onset of deafness followed a single violent concussion. Repeated-blast deafness is the type in which impairment of hearing occurred gradually, after repeated exposures over a period of days, months, or years. A total of 183 cases of blast deafness were treated at the Hoff hearing center.

The term "narcosynthesis" was selected by Colonel Grinker and his associate, Maj. J. P. Spiegel, because under narcosis the patient "* * * actually synthesizes the emotions and memories connected with his experience, putting together what has lain fragmented between consciousness and unconsciousness into a complete whole, which corresponds in almost every detail with the original experience." Thus, under the influence of the drug, a release of intense repressed emotion is secured and the ego, freed from the force of these repressed emotions, "* * * can approach the traumatic situation and, to some extent, deal with it."

The term "psychogenic deafness" is used in this study to include all types of functional loss of hearing, no attempt being made at classification of cases from the psychiatric point of view.

HISTORICAL NOTE [2]

Numerous methods of therapy were employed in the treatment of hysterical deafness in World War I, all of them empirical except in the sense that they recognized the underlying hysterical factor. These methods included:

1. *Faradization.* This involved the use of a very weak electric current applied in an atmosphere strongly suggesting serious medical "treatment" for deafness. The procedure was carried out in a darkened room, with the patient's eyes bandaged and eustachian catheters in place, and with the head support so tightened as to produce the sensation of an iron circle about the head. As the current was applied, the patient was told, "Now you can hear!" This method was advocated by German physicians.

2. *Sudden wakening of the patient from sleep.* This method of treatment was adopted in line with Babinski's law that hysterical symptoms, since they are the result of suggestion, should not persist during sleep.

3. *Hypnotism.* Many successes were reported to follow this method of treatment, including the 15 cures in 32 instances of deaf-mutism reported by Lannois and Chavanne (cited by Loeb) at a single seance.

4. *Sudden distraction of the patient.* The examining otologist focused the patient's attention on the mechanisms of the examination or on some other subject or object, after which he would begin to ask apparently routine questions, which were often answered quite as routinely before the patient realized what he was doing.

5. *Flushing the external ear with cold water.* This form of treatment was employed to produce vertigo and, as in faradization, suddenly shouting through a long tube, "Now you can hear again!"

6. *Autosuggestion.* The role of autosuggestion was emphasized by Hurst and Peters [3] in patients deafened by a single shellblast or repeated concussions. In their opinion, this type of deafness was likely to be hysterical unless rupture of the tympanum was followed by middle-ear infection, when slight deafness on an organic basis might develop. They reported two cases in which, all other methods having failed, the patients were told that surgery would be necessary. One patient accepted the proposal eagerly. The other required considerable persuasion. "Operation" consisted of making two small superficial incisions behind the ear and suturing them. While this procedure was being carried out under light anesthesia, a loud noise was made and repeated. Both patients "jumped off the table" and were able to hear normally.

One of the patients, though he stated that he heard better than ever before, was found to have a slight but real loss of hearing caused by chronic catarrh; evidently he had true organic deafness with functional overlay, probably the

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[2] Loeb, H. W.: Military Surgery of the Ear, Nose and Throat. Medical War Manual No. 8. Philadelphia and New York: Lea & Febiger, 1918.

[3] Hurst, A. F., and Peters, E. A.: A Report on the Pathology, Diagnosis, and Treatment of Absolute Hysterical Deafness in Soldiers. Lancet 2: 547–549, 6 Oct. 1917.

result of gun practice. At Hoff General Hospital, a similar combined type of deafness was observed in a control case selected for narcosynthesis in spite of a convincing history and an audiogram indicating longstanding nerve involvement. The patient talked enthusiastically of his improvement in hearing following narcosynthesis, though the audiogram belied the report. The explanation seemed to be that, believing that he was actually much better, he listened more intently, rejecting nothing which was received at the ear, whereas formerly his acceptance of auditory stimuli often ceased at the cochlea.

7. *Anesthesia (etherization).* Ether was administered to the patient. During the stage of recovery, he was aroused suddenly and thus discovered that he was no longer mute or deaf. Fazio (cited by Loeb) stated that he personally had reported a number of cures by this method at the Congress of Naples in 1897. He believed that etherization did not act by suggestion but by obscuring the consciousness and the mentality of the patient so that he might be withdrawn from the inhibitory influence of a falsely acquired conviction and from the fixed idea that he could not speak.

Zilboorg [4] mentioned diagnosis by etherization in 1944, with emphasis on the period when the patient is coming out of the excitement induced by it, just as the English had emphasized this phase. There was no elaboration of prenarcotic psychotherapy.

8. *General methods.* This included hygiene, hydrotherapy, and exercise, which many otologists believed to be the best plan of treatment in cases of presumed hysterical deafness. Reeducation, by which they meant training in listening to and interpreting sound (usually beginning with gross sounds such as those made by tuning forks and sirens), and lipreading were also considered of importance. All agreed, however, that repeated examinations were contraindicated, and Hurst [5] strongly condemned instruction in lipreading on the ground that this would encourage the patient to become more and more convinced that he was permanently deaf.

POSSIBLE EXPLANATIONS OF HYSTERICAL DEAFNESS

Hurst and Peters,[6] in 1917, explained hysterical deafness as follows: Hearing requires listening. In hysterical deafness, the patient is convinced that he cannot hear and therefore he does not listen; sound vibrations reach the ear in the normal way, but they do not give rise to the slightest auditory sensation because of the patient's inattention. The synapses at one or more of the cell stations in the auditory path to the cerebral cortex must therefore be unswitched. When his hysteria is cured, the patient listens, and the unswitched synapse is once more switched on. It was Hurst's opinion [7] (expressed

[4] Zilboorg, G.: Some Aspects of Psychiatry in the U. S. S. R. Am. Rev. Soviet Med. 1: 562–575, August 1944.
[5] Hurst, A., et al.: Medical Diseases of the War, ed. 4. Baltimore: William Wood & Co., 1944.
[6] See footnote 3, p. 475.
[7] See footnote 5.

in 1944) that this type of deafness occurs most frequently in otherwise normal individuals, with no symptoms or history of deafness, though he had also observed it in those with a neuropathic disposition.

Harbert,[8] in 1943, discussed the dissociation between the perception of pure sound and of complex sounds, such as speech, which some hysterically deafened patients exhibit. A patient may have normal hearing by the audiogram but allege deafness for speech. The reverse of this situation was observed in some of the cases investigated under narcosynthesis at Hoff General Hospital when, following narcosis, the patients heard soft speech easily but showed only partial improvement on the audiogram. Cases were also observed, similar to those reported by Harbert, in which audiograms were nearly normal but in which there was severe loss of hearing for speech.

Naval otologists, according to Lederer,[9] recognized what they termed situational deafness; that is, the patient reported a history of hearing loss, ordinarily associated with exposure to gunfire, blast, or the noise of heavy machinery. The auditory impairment was supported by evidence from both functional and audiometric tests. The duration of the disability, however, was apt to be relatively short, and, occasionally, after a change in environment and the passage of time, hearing acuity improved. In the meantime, the man had reported his deafness to the medical officer, and, through fear of censure or of the accusation of malingering, he continued to state that he did not hear, becoming more and more involved in his own deception. Bizarre discrepancies usually made the condition evident, and an understanding attitude on the part of the medical officer could clear it up promptly.

Situational deafness, according to Lederer, is a legitimate corollary of exposure to blast and noise. The initial deafness, although temporary, is nonetheless profound and is a true sensory experience. Symptoms continue long enough to invoke a definite pattern of response. When they diminish, the patient finds himself still responding to the behavior pattern and is apt to become confused in the attempt to rationalize his recovery of hearing with the recent experience of profound deafness. This confusion leads him to continue to behave as if symptoms were present, and a situation is set up which amounts to a de facto deception.

Malingering. In a discussion in 1917 before the Royal Society of Medicine on war-incurred injuries and neuroses, Marriage[10] distinguished between hysterical deafness and malingering. The malingerer, he pointed out, is usually sullen and defiant, has all his wits about him, and replies after deliberation, whereas a patient with psychic deafness is likely to present all the signs and symptoms of a nervous breakdown. At the Hoff center, a patient who was

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[8] Harbert, F.: Functional and Simulated Deafness. U. S. Nav. M. Bull. 41: 458-471, March 1943.

Lederer, F. L.: Hearing and Speech Rehabilitation. Hearing Loss in the Navy and Marine Corps: Incidence, Etiology, and Statistical Analysis. U. S. Nav. M. Bull. (Supp.) March 1946, pp. 194-201.

[10] Marriage, H. J.: Special Discussion of Warfare Injuries and Neuroses. Proc. Roy. Soc. Med. (Sect. Otol.) 10: 47-56, 16 Feb. 1917.

first believed to be suffering from hysterical deafness suddenly became bellicose and even abusive toward one of the teachers of lipreading when he discovered that she was the first to suspect that he did not have true organic deafness. Although it was never proved, it was thought that this patient was malingering.

Harbert, in 1943, also pointed out that whereas the true hysterically deafened patient is almost always indifferent, the malingerer is often sulky and bellicose, though he may also try to impress the examiner with his uncommon honesty and cooperation. A soldier at the Hoff center precisely fitted this description. He was most apologetic about his deafness and appeared deeply grieved over the difficulties it caused others. After several weeks of deception, he unmasked himself.

TECHNIQUE OF NARCOSYNTHESIS

The treatment of patients selected for narcotherapy at Hoff General Hospital was carried out by the psychologist under the direct supervision of the chief of the Neuropsychiatric Section. Intense suggestion was first given to the patient in three or four interviews, in the course of which he was repeatedly told that he would eventually hear normally. If it was thought that the impairment of hearing was entirely on a functional basis, the patient was introduced to other patients who had recovered their hearing through narcosynthesis. The evidence of success was always of great value. Group suggestion was also carried out in typical Army informal discussion groups, in which patients who had been treated and those who were about to be treated were brought together to talk over their difficulties.

When the psychologic preparation for treatment was thought to be adequate, the patient was given Pentothal Sodium (thiopental sodium) on a very light level (usually between 0.25 and 0.8 gm. of a 2.5- to 5-percent solution). As it was administered at the rate of 0.1 gm. per minute, he was instructed to count backward from 100 to 1. As a rule, he became incoherent before he had counted to 50. The anesthetist then regulated the speed of injection to maintain the so-called babbling narcotized stage. As anesthesia was induced, the patient was asked simple questions and was repeatedly told that he would recover his hearing. At the same time, the external ear was sprayed with ethyl chloride, to produce definite temperature changes, after which the reassurance concerning restoration of hearing was again repeated. Further questions were asked about the traumatic experience and about the family and childhood development. Sometimes a good deal of suggestion and persuasion was necessary before answers could be secured. As the patient was questioned, first one ear and then the other was blocked and tested.

The total procedure occupied about 20 minutes. The patient was observed continuously for the next hour or two or longer if it was thought that there was willful simulation of deafness. During the whole time, until he became fully conscious and realized that he was really hearing, he was constantly

assured that his hearing was normal. In selected cases, Sodium Amytal (amobarbital sodium) was given orally to prolong the narcotic state.

As soon as possible following narcosis, audiometric and whispered- and spoken-voice tests were carried out and recorded. Pure-tone audiometric tests were always run by the same technician, who had been trained by the psychologist in the proper management of these cases. The tests were repeated the following day and as often as necessary thereafter to determine the exact threshold of hearing. Recorded speech-perception tests were carried out if there was any question about the results of live-voice tests.

The attention factor was very important in testing a patient who was slightly stuporous, and it was necessary that the psychologist remain with him and constantly call his attention to the fact that the tester was trying to get a response.

After the treatment, emotional blocks and conflicts which might have caused symptoms of hysteria were carefully evaluated and were approached psychologically in an attempt to prevent a recurrence of symptoms. Occasional patients, when they became conscious that they were hearing, suddenly reverted to their former state of deafness, but, in such cases, willful simulation of symptoms was the rule.

ANALYSIS OF CASES

Of 650 patients admitted to the aural-rehabilitation center at Hoff General Hospital during the 9-month period ending in October 1945, 102 (15.7 percent) were selected for treatment by narcosynthesis. Of the 102, 76 (74.5 percent) showed either a marked improvement in hearing or a complete return to normal. During the same period, 17 other patients who were not investigated under narcosis showed greatly improved hearing in the absence of any specific treatment; unquestionably, some malingerers were included in this group. Sixty-eight other patients who were thought to suffer from functional deafness could not be investigated under narcosynthesis because of inadequate facilities and limited personnel.

The best results in narcosynthesis were achieved in patients who relived their experiences, whether combat or noncombat, while under light narcosis and thus achieved a final relief of tension. Three patients whose audiograms and clinical histories indicated true perceptive deafness of long duration were accepted for interview under narcosis to determine the effect of strong suggestion in the absence of functional overlay. All reported that following narcosynthesis they "heard much better" while at the moving picture and listening to the radio and in other difficult hearing situations. In all three cases, postnarcosis hearing tests revealed exactly the same results as before the interview under narcosis.

Of the 76 patients whose hearing impairment was established by narcosynthesis as of functional origin, 42 had a history of defective hearing before they entered military service. In 25 cases, the auditory difficulties had been ap-

parent for more than 10 years. These observations substantiated the clinical observation that functional deafness found in military personnel during wartime was not always the result of conditions peculiar to military service. In fact, only 12 patients (16 percent of the group whose deafness was functional) incurred their disability in overseas combat areas.

Blast deafness. During the 9-month period in which narcosynthesis was employed in the diagnosis and treatment of functional deafness, 77 patients were admitted to the hearing center with a history of defective hearing following exposure to blasts. In 64 cases, the impairment resulted from a single exposure, and in 13 it resulted from the cumulative effects of a series of concussions. Forty-six patients (60 percent of the blast group) were believed to have true organic deafness. Twenty-one of the other 31 patients, all but one of whom had been treated by narcosynthesis, were classified as having definite functional deafness, and in the remaining 10 cases the hearing impairment was considered to be of possible functional origin.

The 20 soldiers who were hospitalized for deafness following concussion and who recovered completely following narcosynthesis were thought to be suffering from hysterotraumatic deafness. All reported complete loss of hearing immediately following the traumatic incident. Hearing was partially recovered a few days later and then was partially or completely lost again after another several days. Apparently these men at first did suffer real deafness which, after organic recovery, left a strong functional residue. In this respect, the Hoff experience with deafness following blast injury and treated by psychologic methods conformed quite closely with the experience in the Soviet Army in which, according to Zilboorg,[11] 50 percent of the cases of deafness acquired under combat conditions was found to be of psychologic origin. At the Hoff center, however, no instances of deaf-mutism were observed, though in one instance functional aphonia was present for 48 hours after treatment and in two others short-lived amnesia developed. Several patients presented other functional manifestations, such as corneal anesthesia, tubular vision, glove anesthesia of the extremities, and stuttering.

Classification of Cases

The classification of cases of auditory impairment used at the Hoff aural-rehabilitation center (table 5) corresponds rather closely with the classification of Zalkind as used by Zilboorg. The patients included in the Russian study, however, were examined almost immediately after injury in combat, whereas the patients treated at the Hoff center were not seen until 1 to 3 months after they had left the zone of combat. In spite of the discrepancy in time, the observations at the Hoff center rather closely paralleled those of the Soviet Army otologists who used light narcosis in the treatment of psychogenic deafness.

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[11] See footnote 4, p. 476.

The classification included three categories: (1) Psychogenic deafness with no organic loss or with slight organic loss for high tones; (2) organic deafness with a large functional overlay; and (3) organic deafness without a functional overlay. It is possible that some of the cases in the third category properly belong in one of the other categories, but this could be determined accurately only if it had been possible to follow them through the number of narcosynthesis interviews necessary to clarify the point.

TABLE 5. *Etiologic distribution of 102 cases of auditory impairment investigated under narcosynthesis*

Type of deafness	Number of cases	Percent
Psychogenic	47	46. 1
Blast	10	9. 8
Other	37	36. 3
Organic, with large functional overlay	29	28. 4
Blast	10	9. 8
Other	19	18. 6
Organic, without functional overlay [1]	26	25. 5
Blast	4	3. 9
Other	22	21. 6

[1] Single narcosis interview.

SELECTION OF PATIENTS FOR NARCOSYNTHESIS

The establishment of criteria for the selection of patients to be studied under narcosis proved interesting and challenging. It was necessary to determine, before the patients were selected, who would take the responsibility of determining the existence of functional deafness and on what basis or evidence the decision would be made. The otologist obviously could best screen the patients in whom an actual pathologic process was present in the ear, but evidence emerging from this study suggests that, even in the presence of positive clinical findings, the possible evidence of a significant functional overlay cannot be ignored. At the Hoff aural-rehabilitation center, every patient, after otologic examination, was further investigated by a clinical psychologist and by a psychiatrist, and additional information was secured from other members of the rehabilitation staff.

Experience soon made it clear that the most effective selection of patients with suspected functional deafness could be made in the light of combined evidence collected from all possible sources. Teachers and acoustic technicians, who sometimes observed a patient for several hours a day, were particularly useful in noting apparent inconsistencies in speech and hearing behavior.

No patient was allowed to enter the rehabilitation program until a complete medical evaluation had been carried out. It was found to be distinctly

harmful to admit psychogenically deafened soldiers to the program before the nonorganic features of their disability were fully understood.

The diagnostic criteria considered in the selection of patients for narcosynthesis, together with their evaluation on the basis of experience, were as follows:

1. A history of deafness inconsistent with a clinical history of deafness on an organic basis.

A patient who reported, for example, "We were on maneuvers when my hearing suddenly went out on me," was likely to be suffering from functional deafness if the otologic examination was essentially negative and if there was no apparent disease or trauma in his history. Cases such as these, on more thorough investigation, often revealed data strongly suggesting a situational explanation of the "sudden" onset of deafness.

2. Inability to repeat the audiogram.

Of 877 patients with organic deafness, 60 (6.9 percent) showed a change in threshold from one test to the next of 10 decibels or more for the frequencies 256–4096 cycles per second, while 17 (22.4 percent) of the 76 patients with proved functional deafness showed this degree of variation.

Many clinicians who have encountered functional deafness are familiar with the repeated audiogram which shows little change in the average pure-tone threshold but which reveals a bizarre variation in contour. What appears to be a fairly common type of picture for high-tone deafness on the first test may become a flat or even a low-tone loss in the second audiogram. The organic and functional cases of deafness at Hoff General Hospital were investigated from this standpoint. Of the patients with organic deafness, 14.5 percent showed a change in the contour of their pure-tone air-conduction audiograms as determined by the application of Carhart's[12] major categories, while 20 percent of those with functional deafness showed such change from the first to the second audiogram.

3. Poor correlation between the results of the audiogram and the results of conversational voice and whispered tests administered under ordinary clinical conditions.

That whispered-voice tests, as administered under ordinary clinical conditions, were not consistent or reliable is supported by the results obtained in this investigation. The organic cases, in fact, show a correlation coefficient of +0.47 between the average audiometric loss in decibels (256–4096 frequencies) and the whisper test, while the coefficient of correlation for the functional cases is +0.39. The results do illustrate the tendency for the functional cases to show a greater loss for pure tones than the organic cases. On the basis of these findings, it would seem inaccurate to question a true organic background for deafness solely on the basis of a loss on the whisper test inconsistent with the audiogram since the variability of the whisper test makes it an unreliable measure of deafness even in cases of true organic hearing loss.

[12] Carhart, R.: An Improved Method for Classifying Audiograms. Laryngoscope 55: 640–662, November 1945.

In spoken-voice tests, there was a more consistent relationship with the audiogram than was apparent in the whispered tests, the coefficient of correlation for the organic cases being +0.65 against +0.49 in the functional cases. Here again, however, emphasis on the results of these tests in the differential diagnosis of functional deafness does not seem warranted unless the findings are bizarre.

4. Absence of changes in voice intensity or quality, in speech patterns, or in both. The experience at the Hoff center was that obvious changes, such as are characteristic of hearing loss, are not usually present in cases of functional deafness.

Of 93 patients with functional deafness studied at this center, 87 showed no voice or speech deviations. In the 6 cases in which such deviations were present, there was no evidence that they were the result of defective hearing, since they were not of a character usually associated with deafness. These figures confirm the observation that speech and voice changes are no more likely to be present in deafness in which there is no true organic lesion than in the general population.

5. A "remarkable" and immediate improvement in hearing as soon as the hearing aid was in place and turned on.

Before narcotherapy became an accepted procedure in the hearing center, 39 patients whose deafness was later diagnosed as functional were fitted with hearing aids. Their aided hearing was measured on the binaural free-field audiogram, and in 36 cases the speech-reception threshold for speech was recorded.

The tests with the hearing aid in place were made in a sound-isolated room. For the pure-tone audiogram, the output of a Maico D–5 audiometer was fed through a Bogen E-75 amplifier to a Western Electric high-fidelity loudspeaker in the testroom, where the patient sat in a special chair, with his head in a fixed position against the headrest. As he perceived each tone, he made a hand signal. This procedure was carried out first without a hearing aid and then with various types of aids. The final improvement, recorded in decibels, was the difference between the unaided threshold and the threshold with the aid finally selected.

The threshold for speech perception was measured under the same conditions. Disyllabic words, selected from lists of spondee words recorded by the Psycho-Acoustic Laboratory for the National Defense Research Committee, were fed in descending levels from a Gates CB–7 transcription turntable through the apparatus just described. The patient repeated aloud to a nearby microphone the words he heard, and they were recorded by the technician in the control room. The difference in thresholds for the unaided ears and with the hearing aid in place was recorded as the improvement in decibels.

Table 6 shows the improvement in decibels of the patients with organic and with functional deafness for pure tones and for speech reception. The number of patients with functional deafness who were fitted with hearing aids

is too small for significant analysis, and the larger standard deviations are most probably due to the smaller numbers involved. If the data show any trend, they illustrate the greater improvement, particularly for pure tones, in the functional as compared with the organic cases. This was expected, since it has often been demonstrated that a patient suffering from psychogenic deafness will frequently display great improvement under the power of strong suggestion, which was provided, in this series, by the hearing aid.

TABLE 6.—*Improvement (in decibels) achieved with hearing aids in organic and functional deafness*

PURE TONES (FREE FIELD)

Type of deafness	Total cases	Mean improvement in decibels	Standard deviation
Organic	691	25. 9	10. 7
Functional	39	36. 6	15. 1

SPEECH RECEPTION THRESHOLD

Organic	482	30. 2	9. 5
Functional	36	33. 9	12. 9

An interesting commentary on the results of treatment by narcosynthesis is the result secured in 10 cases in which, prior to the introduction of this method, hearing aids were dispensed having an arrangement for a 90-volt B-battery supply in place of the usual maximum of 45 volts. This unorthodox aid was used with results considered little short of miraculous in patients who showed through the orthodox aids nearly complete or complete loss for pure tones and no hearing for speech. After the introduction of narcosynthesis, it was found necessary to supply only one special aid of this kind, in a case of deafness following a severe labyrinthitis. All other patients who would previously have been considered for it were demonstrated to have functional deafness.

6. A "phenomenal" ability to read lips, often under fantastically unfavorable conditions.

When lipreading ability of so unusual a degree was professed, simulation was strongly suspected, particularly when the patient understood speech when the speaker's mouth was not visible to him. This situation is well known to all otologists.

7. Normal labyrinthine function associated with severe hearing loss.

Of a total of 22 patients with hysterotraumatic deafness who were tested for labyrinth function, only 3 showed markedly decreased or absent vestibular

activity in the right ear and only 4 in the left ear. The number of cases, again, is too small to permit generalizations.

8. The presence of hearing by bone conduction in cases in which there is severe or total loss of hearing by air conduction.

As table 7 shows, patients with psychogenic deafness measured by air conduction tend to show a complete loss by bone conduction as well. Of 13 patients with total loss for air conduction, only 3 admitted any hearing by bone conduction. These observations agree with the findings of British observers after World War I.

TABLE 7.— *Bone conduction versus air conduction in functional deafness (right ears only)*

Loss of hearing for air conduction	Loss of hearing for bone conduction			
	Number of cases			
Decibels	Cases	0–29 decibels	30–59 decibels	Total loss
0–29	1	0	0	1
30–59	17	3	12	2
60–98	42	0	23	19
Total loss	13	0	3	10
Total	73	3	38	32

CASE HISTORIES

The following case histories are included to illustrate hysterical conversion and malingering.

Hysterical Conversion

Case 1.—A dental officer reported that for 7 years he had suffered from impairment of hearing without apparent cause. His mother was hard of hearing, and an uncle and two aunts were deaf. His clinical history suggested a pathologic process in the ear, and he complained of a pulsing tinnitus. He had entered the Army on limited service because of his hearing. The results of the whisper test at the hearing center were 0/15 in each ear and of the spoken-voice test 0/20 in each ear. The right ear showed some response for pure tones at 90 and 100 decibels. The left ear showed a complete loss.

It was thought, from the first, that this patient did not have the hearing loss revealed by the tests, though he objected strenuously to all suggestions that narcosynthesis be employed, on the ground that it was a reflection on his integrity. After direct psychotherapy, however, he finally agreed to the interview. Following intravenous thiopental sodium therapy, the hearing in the left ear for the spoken voice was a true 20/20, with no audiometric loss, while on the right side, the voice test showed 4/20 with an audiometric loss of 35 decibels. Apparently, most of the patient's hearing loss was on a functional basis and was a conversion hysteria. His hearing remained good over several weeks' observation.

The case clearly illustrates the need for thorough investigation, even in the face of a substantial clinical and family history of organic deafness.

Case 2.— This patient, formerly a railroad switchman, had been hard of hearing for 13 years, following an accident in the railroad yards in icy weather. He showed slight response to the audiometer on the right side and none on the left. During narcosynthesis, it became apparent that the deafness was a conversion hysteria, based directly on the traumatic experience in the railroad yard 13 years before. Following the interview, hearing was completely normal in the right ear, and on the left side the only loss was for high tones beyond 2048 cycles. The patient also reported great emotional relief.

This was one of the cases reported as of more than 10 years' duration. The residual loss for high tones was fairly typical of this group.

Case 3.—A 19-year-old soldier, with a maternal fixation, who had evidently suffered emotionally in the Army, returned from a combat area complaining of complete deafness following the concussion of an exploding shell. A hearing aid with a 90-volt B-battery supply was tried with immediate success. The patient showed great elation upon being able to hear clearly once again. After he returned from a furlough at home, it was noted that he had the gain control of the aid set at the minimum point. This bizarre improvement pointed to a functional involvement. During thiopental sodium narcosis, he readily answered questions asked in a soft voice and was able to hear normally afterward. Almost immediately, however, he began to complain of symptoms referable to the stomach, which were evidently a new manifestation of a conversion hysteria.

Case 4.—This 27-year-old patient, after seeing a great deal of combat, was eventually wounded by an 88-mm. shell which caused him to lose consciousness immediately. He reported that he remembered nothing which followed. When he was first examined, he had definite signs of war neurosis and complained of vertigo and tinnitus. His hearing on the whisper test was zero feet on the right and one-half foot on the left; to the spoken voice, it was zero feet on the right and 2 feet on the left. The left ear showed a loss of 95 decibels to pure tones; on the right, there was no response. A 40-decibel threshold for bone conduction was admitted. The patient appeared dazed, uninterested, and apathetic toward lipreading instruction, and stared fixedly at the face of the instructor. When he was fitted with a powerful hearing aid with a 90-volt battery, he suddenly heard clearly, which suggested that the deafness was at least in part on a functional basis. At the time he was under treatment, narcosynthesis had not yet been introduced.

This case fits Marriage's [13] description of true hysteria.

Malingering

Case 5.—This patient, from an armored division alerted for overseas duty, was sent from Camp Cook to Hoff General Hospital. Examination revealed bilateral defective hearing, apparently of the perceptive type. The patient stated that he had been hard of hearing since childhood and that gunfire of any kind aggravated the deafness. His hearing on the whispered test was one-half foot bilaterally and on the spoken-voice test 1 foot bilaterally. The audiometric loss on the right was 85 decibels and on the left 90 decibels. The first and second audiograms were similar, and there was no reason to suspect malingering until the patient entered the sound-isolated room for tests of speech perception, with the assurance that everything possible would be done to help him. During this test, the examining officer, who had suspected the first responses, encouraged the patient to respond to words presented with decreasing intensity until the threshold for normal hearing was

[13] See footnote 10, p. 477.

reached. The patient apparently did not suspect what he had revealed until he had left the sound-isolated room. Then it apparently dawned on him, and, within a few minutes, he returned with a very red face to explain his deafness to the examining officer as "the result of a cold the previous week."

This patient had prepared himself carefully to carry out the deception but was upset when his yardstick of the degree of deafness was destroyed in the speech-perception test.

Case 6.—A warrant officer stated that he had first noticed defective hearing about 9 months earlier, following 4 weeks' practice in rifle firing. He had suffered from tinnitus throughout that period. His father was also hard of hearing. The first tests suggested defective hearing, perceptive in type. Hearing tests revealed bilateral hearing 0/15 for the whisper test and 3/20 with the spoken voice. The patient did not admit hearing any pure tones by air conduction or bone conduction. Also, until eight had been tried, he insisted that he could hear nothing with hearing aids; then he admitted very slight improvement. In auditory training, lipreading, and other classes, in which he normally should have showed some progress, he admitted to none. His deafness had been questioned from the beginning, and a special conference of the entire staff led to the unanimous agreement that it was undoubtedly simulated. After several weeks, the patient, of his own accord, decided to drop his pretense. He merely marched into the office of the chief of the program, deposited his hearing aid, and stated, "I can hear."

CONCLUSIONS

1. The use of narcosynthesis in the evaluation and therapy of functional deafness at the Hoff General Hospital aural-rehabilitation center showed it to be an effective technique for these purposes, whether the auditory impairment was of long or short duration. Only about 16 percent of the improved patients had combat-incurred deafness, while about 55 percent had a history of auditory impairment preceding induction, which sometimes was associated with clinical evidence of aural disease. These proportions suggest that the incidence of psychogenic deafness in civilian life may be significant.

2. Functional deafness often occurred as an exaggeration of true organic loss of hearing.

3. Patients with functional deafness were less able to repeat the threshold and contour of their original audiograms than were those with true organic impairment.

4. Inconsistences between the results of the audiogram and the results of the whisper- and conversational-voice tests were often illusory in the diagnosis of functional deafness. Suggestive evidence of this type of hearing impairment was (1) absence of voice or speech changes in patients with severe deafness, (2) a "phenomenal" ability to read lips, and (3) a "remarkable" improvement in hearing with a hearing aid by patients with audiometric proof of total or near-total deafness.

5. The diagnosis of functional or psychogenic deafness is not easy and is justified only after a careful study of all the evidence. The temptation must be avoided to regard this diagnosis as a convenient diagnostic wastebasket into which may be put all difficult or unorthodox cases of hearing impairment.

CHAPTER V

Auditory Impairment Due to Battle-Incurred Acoustic Trauma

Myron M. Hipskind, M. D.

The incidence of aural casualties remained high during World War II, in spite of the fact that for many years preceding it the War Department had been keenly interested in preventive measures. Helmets had been specially designed and earphones, ear obturators, gun shields, and gun charges had been studied, with the objective of minimizing auditory damage. Directives had been issued outlining principles of protection, stressing the proper position of guns, describing various methods to protect combatants from the effects of blast, and providing for men long in action to be given rest periods to permit recovery from temporary injuries to the ear. None of these measures, however, proved fully effective in World War II.

Among the approximately 36,000 surgical patients treated at the 108th General Hospital in Paris during World War II,[1] aural casualties represented 5.8 percent. This proportion, it should be emphasized, represents only the known casualties; that is, patients who were seen in the clinic because they had aural complaints or because aural damage was suspected and was later diagnosed by audiometric methods. Undoubtedly, other patients with damage to the ears were overlooked, but it was physically impossible to investigate from this standpoint all the patients admitted to the hospital.

The incidence of aural casualties was always influenced by the time at which the patient was seen by the otologist. The patients discussed in this chapter were seen at periods averaging 10 days but varying from 1 to 144 days after injury. Obviously, temporary deafness of short duration would have disappeared by the time most of the patients were seen, while the incidence of aural disability would undoubtedly have been increased if all the patients could have been observed for longer periods of time, after their more serious wounds had ceased to engage their attention.

ROUTINE OF INVESTIGATION

The form (fig. 12) used for the collection of data for the 213 patients reported in this chapter made possible the rapid, efficient tabulation of the

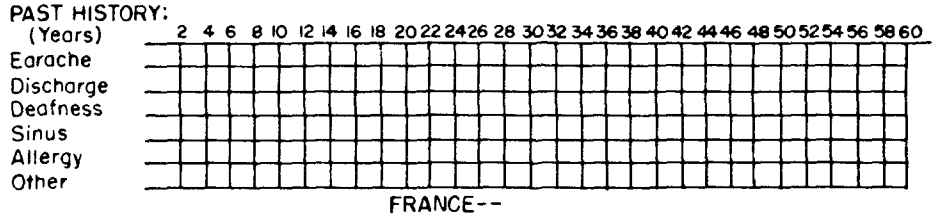
[1] Annual Reports, 108th General Hospital, 1944-45.

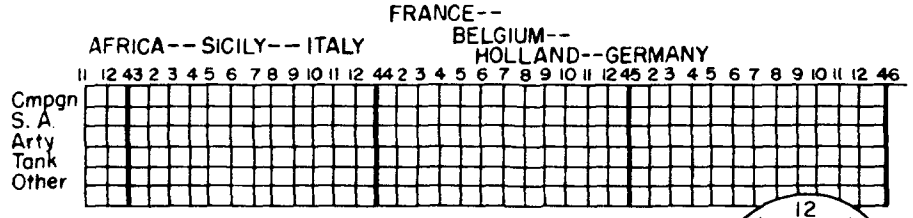
NAME _____ ASN _____ GR ___ REG & ARM OR SERVICE _____
RC ___ NT ___ DATE OF ADM _____ AGE ___ WD ___ SERVICE ___ PENICILLIN _____
ARMY OCCUPATION: SULFA DRUG _____
CIVILIAN OCCUPATION: DISPOSITION _____
ADMITTING DIAGNOSIS: HELMET _____

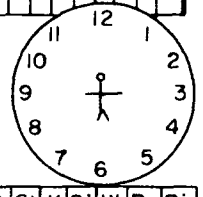
FINAL DIAGNOSIS:

CHIEF COMPLAINT:

PAST HISTORY:







P	St	K	Si	W	Ru	Ri
FH	R	T	Ht	Ov	W	C-E

Traumatizing Noise
Auditory Sensation
Deafness
Tinnitis
Bleeding
Discharge
Other
Brief History

PALPITATION SWEATING NOISE SENSITIVITY TREMULOUSNESS DEPRESSION EMOT. INSTAB. AMNESIA CONFUSION INSOMNIA NIGHTMARES PANIC VERTIGO MEMORY DECREASE OTHER
IMPRESSION: ANXIETY STATE HYSTERIA LA-BELLE INDIFFERNCE COMPULSION MILD SEV.

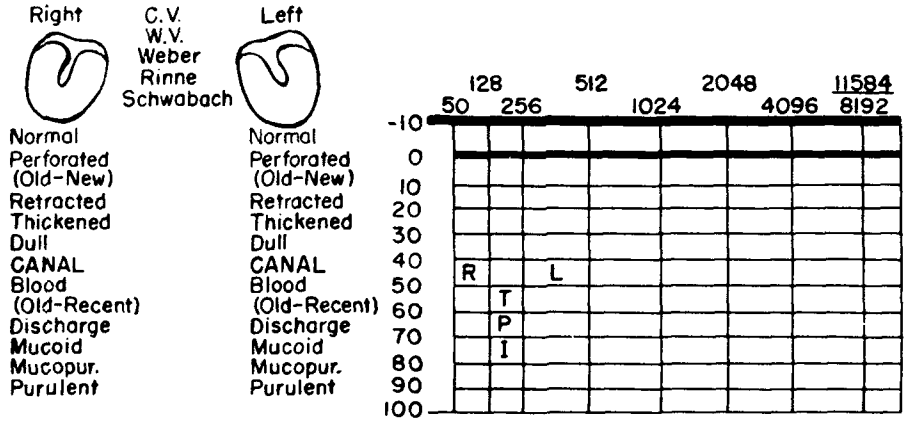


FIGURE 12.—Form used for collection of data in cases of suspected battle-incurred acoustic damage.

information desired.[2] Most of the entries are self-explanatory. The clock-like diagram at the right provided a simple, accurate illustration of the course and area of detonation of the shell or other traumatizing agent in relation to the position of the soldier at the time of the explosion. Changes in the eardrum were sketched in the schematic representation at the lower left, while the condition of the drum and canal was indicated by checks of the appropriate entries in the columns below. The usual audiographic form was employed with the addition of the symbols R (right), L (left), T (tinnitus), P (pitch), and I (intensity), which were checked at the time of audiometric testing if the patient volunteered the information that the test sound was similar to his subjective tinnitus. In this event, an additional effort was made to determine and record the intensity.

Conditions of war made it necessary to include in each investigation a screening impression of the individual's adjustment to his environment. Each patient was given every opportunity to express in his own words all the auditory difficulties which troubled him subjectively, but the practice of obtaining a history by leading or direct questions was conscientiously avoided.

The standard principles of audiometry were followed in all examinations. The operator of the audiometer, who was trained in these essentials, personally conducted all tests, which included whisper and conversational voice tests; the Weber, Rinne, and Schwabach tests; and, finally, audiometric tests. All tests were carried out in a soundproofed room. Calibration of the audiometer was checked at the beginning of each day's work, and the first tests of the day, as will be pointed out, were made on individuals of the control, and presumably normal, group.

The first tone used was a 1024 cycle, with subsequent orderly progress to the highest frequency. By this method of testing, fatigue to the ear as a result of a prolonged period of testing the lowest to the highest frequency was avoided. A reasonably loud signal was given, based upon the apparent hearing loss to a whisper or to the conversational voice. Attenuation was introduced in 5-decibel steps until no response was indicated. This maneuver was repeated until a uniform response had been obtained three times. The sound was frequently interrupted, and care was taken to avoid the possibility of audible or visual recognition of the action. Masking was used in any case in which a disparity of 30 decibels or more was demonstrated between the ears, though in no case did the masking intensity reach a level which would unfavorably influence the ear being tested.

CLASSIFICATION AND ANALYSIS OF CASES

In the early period of the fighting in Europe, aural casualties returning from the front presented problems of classification. The multiple variations

[2] It should be noted that, although this study concerns 213 casualties, computations are made on the basis of deafness in ears and not in patients, as indicated by subjective symptoms. This was necessary for two reasons: (1) Some patients were unilaterally and some bilaterally deafened. (2) All patients were not aware of their auditory impairment. Acoustic trauma was manifested by elevations at 4096 in patients who were unaware of any loss of hearing.

of type and degree of hearing impairment which could occur under similar etiologic conditions were extremely confusing, and the vital need for accumulating pertinent data relative to combat-incurred acoustic trauma became obvious. To secure it, the case records of 170 soldiers (not included in this analysis) who complained of hearing impairment caused by explosions were reviewed. The information thus acquired suggested that categorization according to certain criteria would simplify the problem. On this basis, the 213 patients who form the material for this chapter, 113 of whom served as controls, were therefore classified into the following categories and subgroups:

Category I. Each patient in this category was a casualty who had been wounded in action and who had complaints referable to the ear and suggestive of recently acquired battle injury. He had no history of ear disease in childhood and no history of exposure to acoustic trauma in civilian life. Clinical examination demonstrated no evidence of previous disease of the ear. The information necessary for this classification was ascertained from the patient's history and checked against the knowledge of signs common to chronic disease of the ear. The patient's account of his civilian occupation could not be adequately evaluated, it is true, but there was little evidence to suggest that the soldier would relate his civilian occupation to the significance ascribed to this factor in this study.

Although 100 patients made up this category, only 199 ears were studied. The left ear of one patient was found to be the site of a preinduction impairment and was therefore excluded from the analysis. The ages of the patients ranged from 19 to 41 years and averaged 26 years. The duration of combat ranged from 1 to 900 days and averaged 122 days. Some of the patients were aware of their hearing impairment, while others, who had no subjective symptoms, had objective evidence of aural trauma.

Initial audiometric testing was conducted without reference to whether evidence of aural trauma was subjective, objective, or both. The composite curve (fig. 13) is the threshold response of the 199 ears. Each frequency of the tested right and left ears was listed in separate columns, and an average was obtained for each frequency.

It should be emphasized that the type of audiometric curve was not a criterion in the selection of the patients in this group and that the curve obtained under the criteria employed was a composite of curves secured under conditions in which the extremes of all the test frequencies ranged from zero to the maximum output of the intensity supplied by the audiometer.[3] The maximum threshold elevation at 4096 cycles is, under the circumstances, impressive. Furthermore, the consistency of the parallel of the response of the right and

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Maximum intensities at various frequencies.

Cycles	*Decibels*	*Cycles*	*Decibels*
50	50	1024	100
128	80	2048	100
256	90	4096	90
512	100	11,584	40

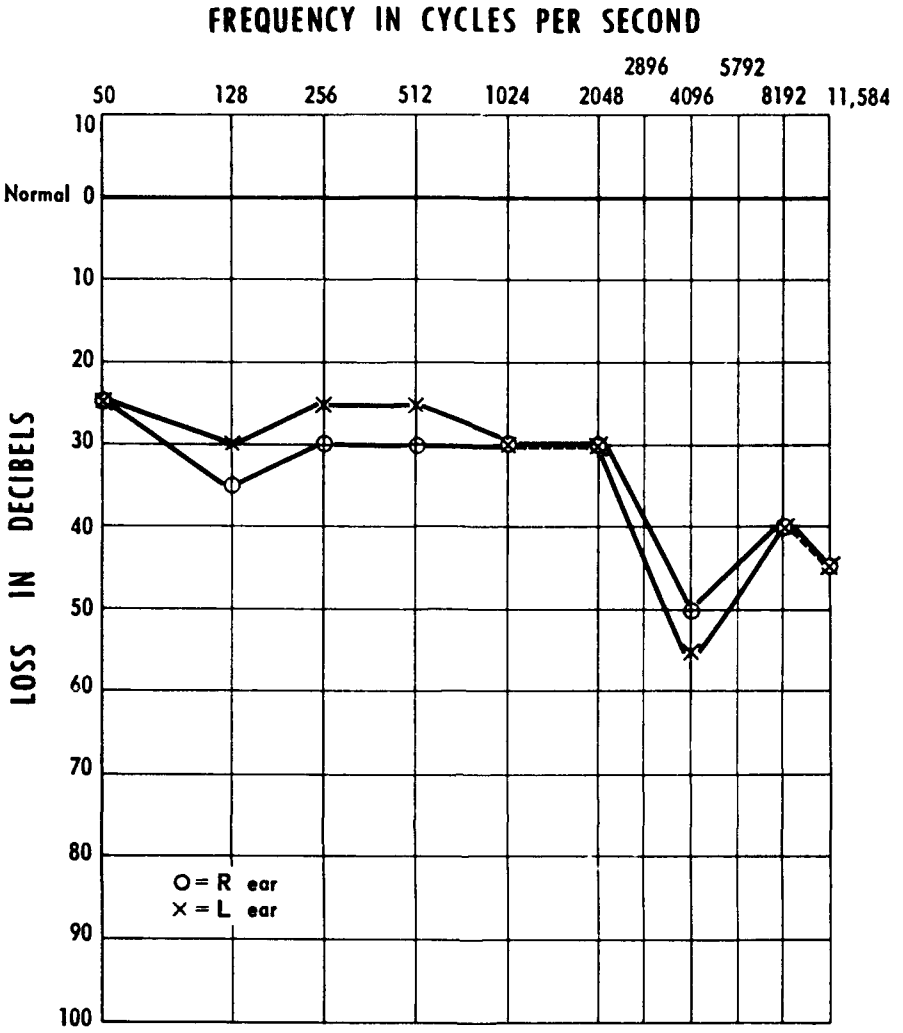


FIGURE 13.—Composite curve showing audiometric loss in 100 patients in whom 100 right ears and 99 left ears were tested.

left ears is striking when one considers the possibilities of digression in a computation of figures extending into hundreds of thousands.

Subgroup A.—The 147 ears (75 right ears and 72 left ears) studied in this subgroup belonged to patients who had only subjective symptoms. The response for subjective frequencies was obtained for the ears to which complaints were referable by discarding from the analysis those ears which were the site of impairment as manifested by a tonal dip at 4096 cycles but to which subjective complaints were not referable. Otherwise, the selection was made under the same conditions of obtaining the group threshold as outlined for category I.

The curve obtained by using only the ear to which complaints were referable (fig. 14) also demonstrates a marked tonal dip at 4096. Of greater interest, however, is evidence suggesting the inclusion of the 8192 cycle (fig. 14).

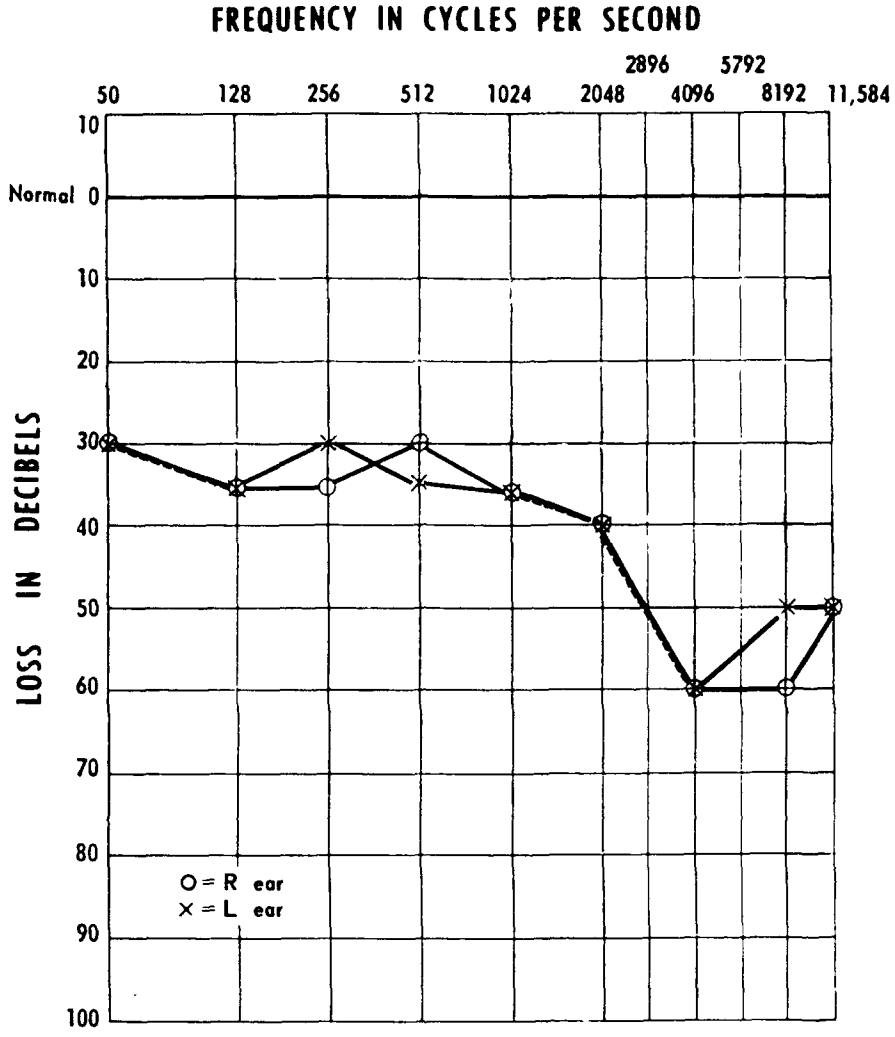


FIGURE 14.—Composite curve showing audiometric loss in patients in whom 75 right ears and 72 left ears were tested. All these patients complained of aural disability.

This phenomenon was thought to be the result either of exposure to acoustic energy of greater intensity or of more prolonged exposure. The maintenance of the parallel tendency for the approximation of the curve of the right and left ears is again demonstrated. It should be observed that there exists a threshold elevation of a general nature for all frequencies as compared to the level of the same frequencies shown in the composite curve (fig. 13).

The tendency for the curve in figure 14 to show a gradual downhill fall is noticeable when it is compared to the composite curve (fig. 13), which is relatively flat and which drops off sharply at 2048 cycles. The discrepancy is not difficult to explain: The composite curve represents a combination of ears characterized by both subjective complaints and objective findings and was elevated by the lesser damage of the ears in which only objective findings were

apparent. From this it follows that, when the threshold response of severely traumatized ears was tested by pure tone frequencies, the curve would demonstrate a general depression in all frequencies, with the maximal dip at 4096 cycles and with lesser dips at 2048 and 8192 cycles.

Subgroup B. Subgroup B consists of 42 ears (25 right ears and 27 left ears) in which acoustic injury was manifested by a high-frequency tonal dip at 4096 cycles but to which subjective complaints were not referred. The impairment in these ears would have been missed if audiometric testing had been limited to patients with subjective symptoms. The contour of the threshold curve for the 25 right and 27 left ears tested (fig. 15) further emphasizes the evidence

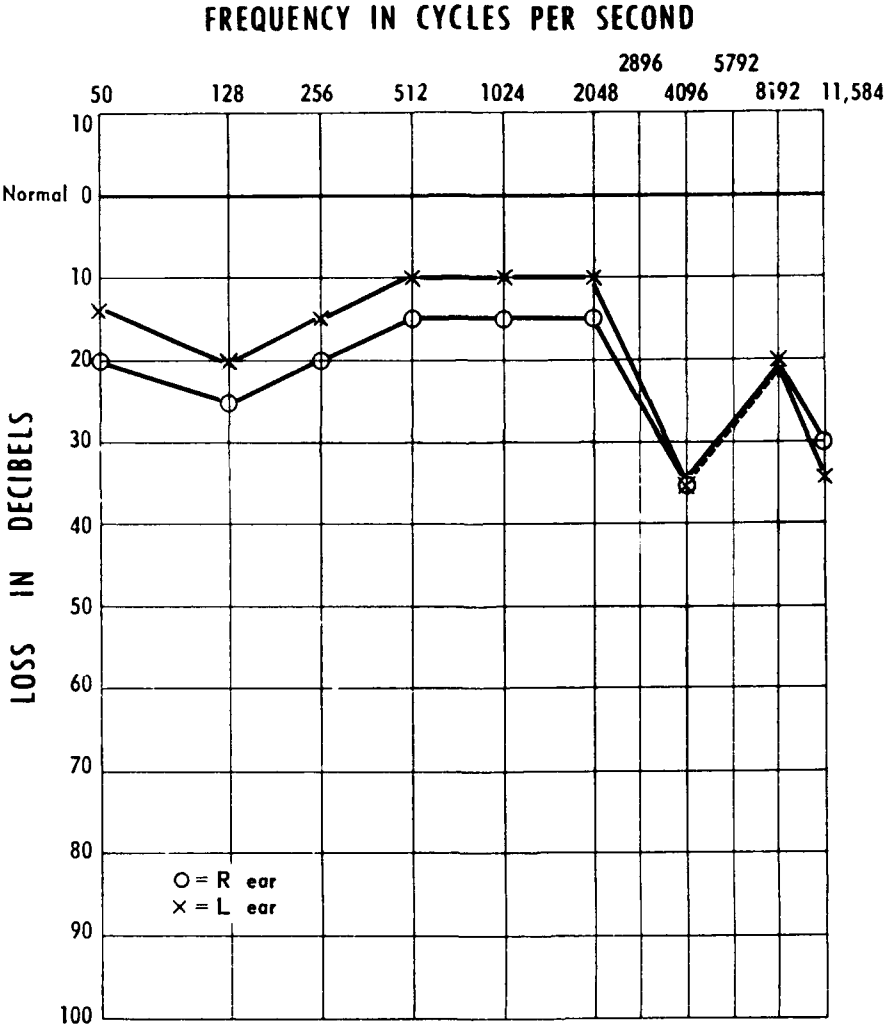


FIGURE 15. — Composite curve showing audiometric loss in patients in whom 25 right and 27 left ears were tested. In this testing phase, no patient had subjective complaints referable to the ear, but all had objective findings. This curve, in which the left ear is more prominent than the right, should be compared with figure 14, in which the right ear is more prominent than the left.

indicative of early acoustic injury to be foreshadowed by a tonal dip at 4096 cycles. The shallow dip at 128 cycles appears in this group, as it does for the entire category, and its regular recurrence indicates that it may be of significance in curves suggesting the pattern of acoustic trauma, though no explanation can be advanced for it.

The 113 patients of the control group were classified as follows:

Category II. This category was composed of 25 officers who had been exposed to blast, had been wounded in action, and had been hospitalized for wounds sustained on the battlefield but not involving the ear.[4] None had a past history of ear disease; none had a past history of exposure to noisy civilian environments; all had clinically normal ears, nose, and throat; and all volunteered for the study. The age range was from 19 to 34 years, and the average age was 26 years. Combat days ranged from 2 to 150 and averaged 70 days. All the officers had a 15/15 response to the Army whisper test. A few patients in this group recalled an occasional singing noise in the ears following an explosion, but none of them volunteered the information until a leading question was asked.

The patients in categories I and II were practically parallel in age. They came from the same battlefields and entered the hospital at the same time. This eliminates environment as a factor. The wounds of the officers in category II were generally similar to those of the enlisted personnel in category I except that the officers had no aural complaints. All the patients studied were well under the age in which high-tone deafness of nerve origin would be associated with the normal decline of hearing acuity for high frequencies to be expected in persons over 50 years of age.

The tonal dip and the general contour of the curve (fig. 16) in this group of officer controls are similar to those of the curve obtained for subgroup IB. The approach to the normal zero line is obviously superior in a control group without complaints referable to the ear but the shadowlike quality of the two curves is demonstrated. The tonal dip is maximal at 4096 cycles, and there is a second dip at 8192 cycles. These observations are particularly interesting if it is borne in mind that there was no subjective injury to the ear in any case.

Category III. This so-called Tom, Dick, and Harry group consisted of 25 patients seen in the outpatient clinic for the same conditions which bring patients to general dispensaries in peacetime, for the most part chronic diseases of the ear associated with longstanding disease of neighboring tissues, usually with a secondary conduction type of deafness. All the patients thus had a history of past or present ear disease. They were chiefly service personnel, engaged in supply and administrative work, and none of them had been exposed to acoustic trauma in the Army or in civilian life. The age range was from 19

[4] There is no significance in the fact that the patients in this control group were officers. Officers, rather than enlisted men, were employed as a matter of convenience. This study was carried on for the most part at night, and it did not break into the routine of the hospital to use officers, who were in small wards or 2-bed rooms. Enlisted men, on the other hand, were in large wards, and it was not practical to awaken a ward of 50 men to secure a single control patient.

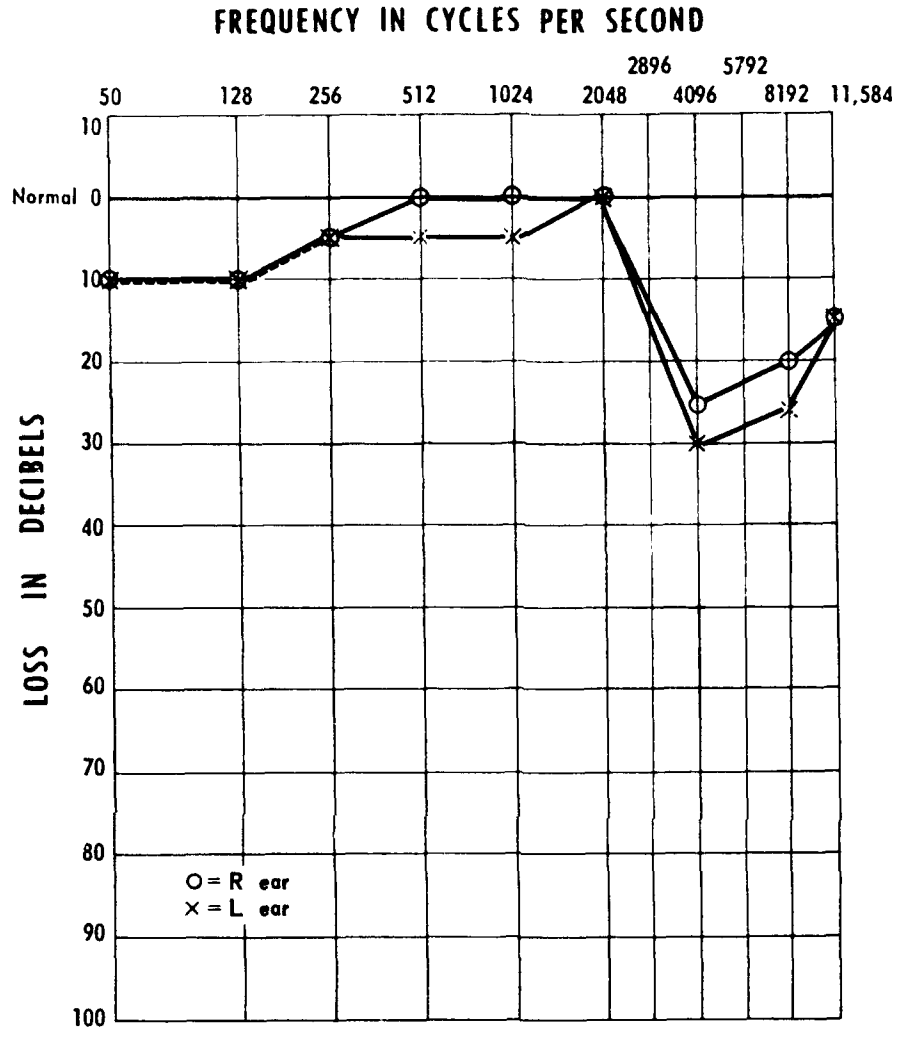


FIGURE 16.—Composite curve showing audiometric findings in 25 patients (category II) who were exposed to combat noise but who had no subjective complaints or objective findings. Both ears were tested.

to 56 years, and the average age was 30 years—4 years more than the average of patients in categories I and II.

The composite curve for this group of patients (fig. 17) shows an absence of the tonal dip at 4096 cycles observed in categories I and II and suggests, in fact, a general uphill tendency.

Category IV.—This category was composed of 25 normal individuals, including some women, who had no personal or family history of aural disease, no history of civilian or Army exposure to acoustic trauma, and no present complaint referable to the ear. Their ears, nose, and throat were clinically negative. The age range was from 20 to 44 years, and the average age was 29 years.

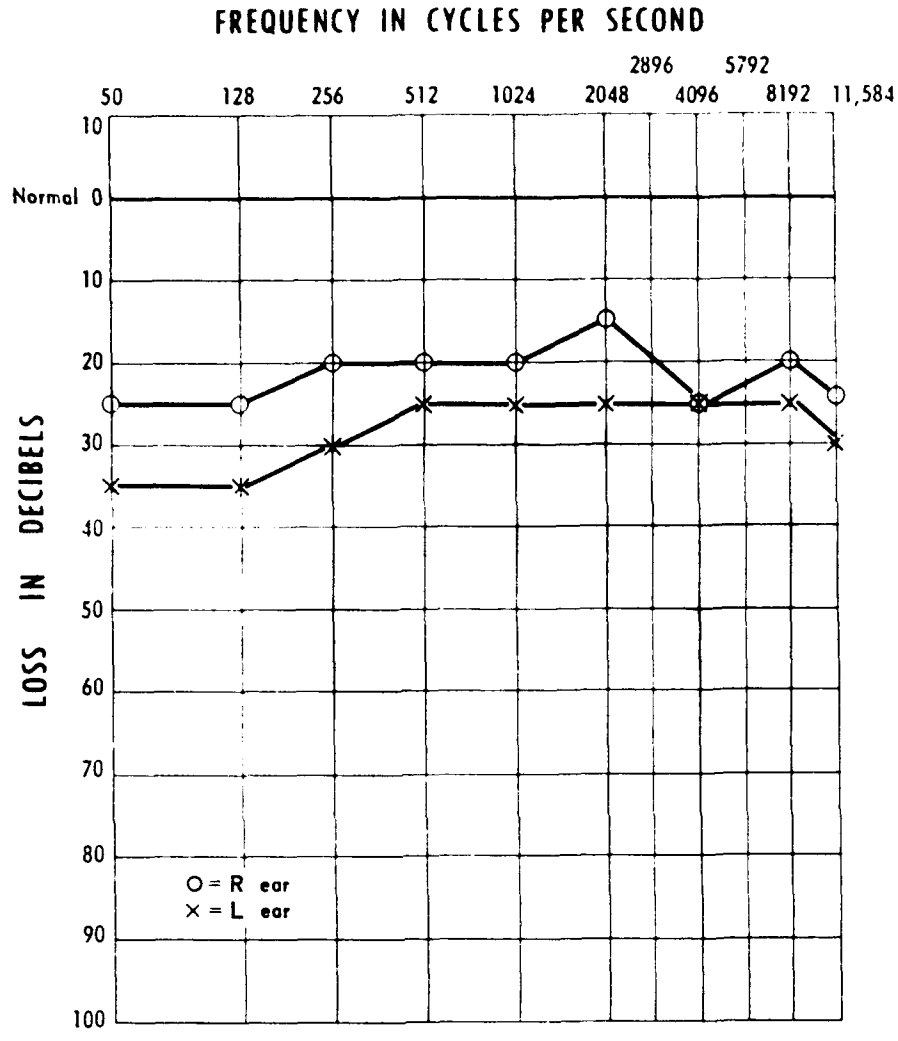


FIGURE 17. Composite curve showing audiometric findings in 25 patients (category III, Tom, Dick, and Harry group) who were not exposed to either combat or civilian acoustic trauma. Both ears were tested.

The composite curve in this group (fig. 18) is near the zero base line. These subjects not only served as a control on other groups but also acted as a valuable check on the efficiency of the technician, the apparatus employed, and the conditions of an external nature that might unfavorably influence the soundproofed room. As already noted, these persons were always tested at the beginning of the day's procedures.

Category V. This category consisted of 38 individuals with past history and clinical findings indicative of defective hearing caused by disease or acoustic trauma, or both, incurred before exposure to battle noise. The age range was from 19 to 42 years, and the average age was 26 years, which compares favorably with the average age of patients in other categories and makes the possible

influence of high-tone loss occurring in late adult life insignificant. The combat days ranged from 2 to 805 and averaged 116, which compares favorably with the average of 122 combat days experienced by patients in category I.

The threshold curve of the patients in category V (fig. 19) should be compared with the curve of the patients of subgroup IA. It will be noted that, from 2048 cycles to 11,584 cycles, a similar pattern is evident in both curves. If acoustic trauma is characterized by a tonal dip at 4096 cycles, it follows that patients with hearing impairments existing before the traumatizing noise of battle are, according to the findings in this group of patients, as vulnerable to the effects of blast as are patients with normal ears. The literature reflects a divided opinion on the subject of whether an increased or decreased resistance

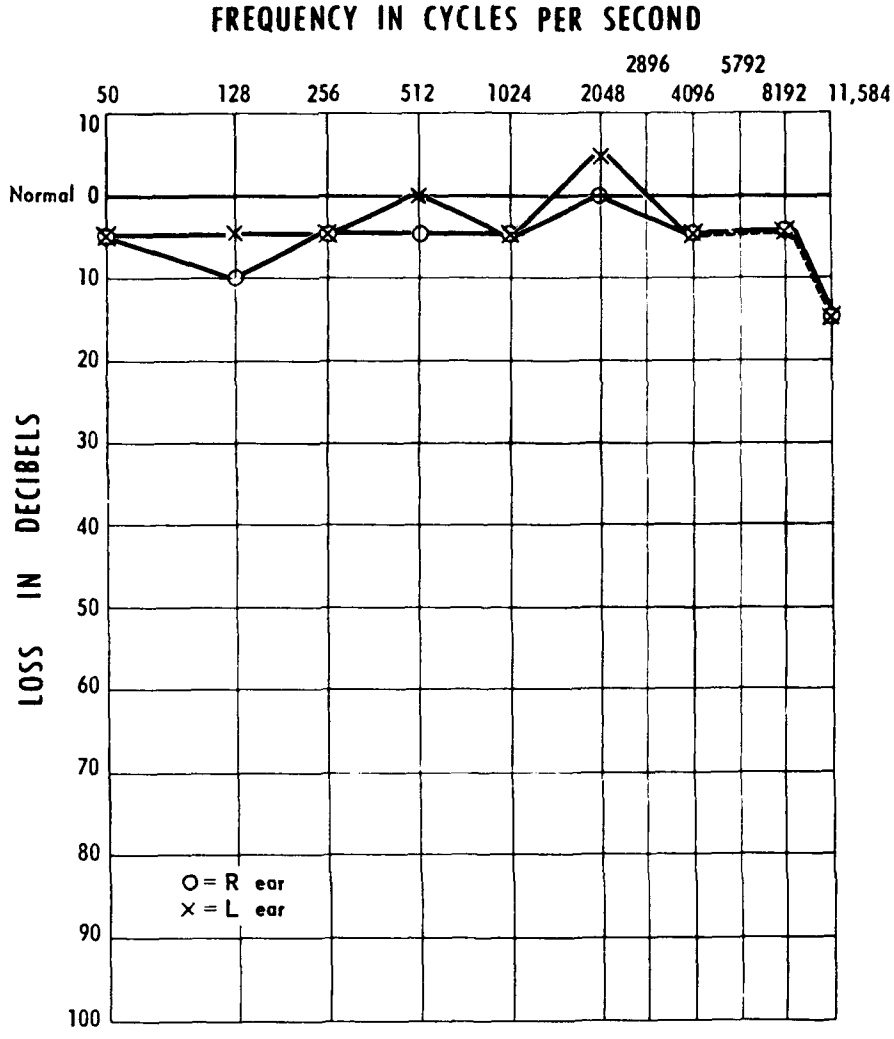


FIGURE 18.—Composite curve showing audiometric findings in 25 normal subjects (category IV), without present or past aural complaints. They had not been exposed to combat.

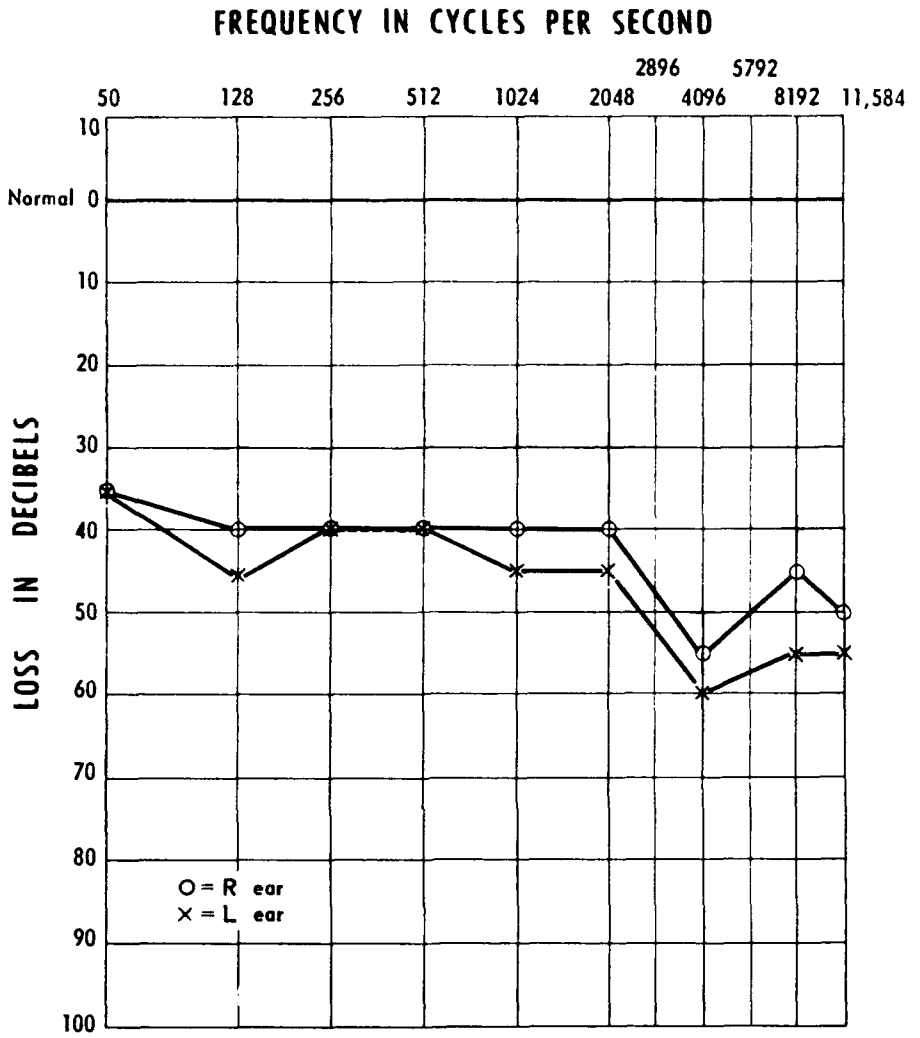


FIGURE 19.—Composite curve showing audiometric loss in 38 patients (category V) who had not been exposed to combat noise but who presented various types of aural impairment existing before induction.

to acoustic trauma develops in ears which are the site of a hearing impairment resulting from childhood or present ear disease or both. A similar controversy exists over resistance to subsequent trauma in instances of defective hearing caused by acoustic trauma in civilian occupations.

The generalized flattening below 2048 cycles observed in the curve in this category is comparable to the curves of categories I and III. It may be assumed to indicate the influence of the battle-incurred threshold increase superimposed on a low-tone deafness and also to indicate that soldiers with previous hearing impairments are as sensitive to subsequent trauma as are those with normal hearing.

In an endeavor to determine the influence of duration of exposure on the threshold curve when testing was carried out under the conditions previously described, the composite curve was determined for 30 ears in patients who had had at least 150 days of combat. The age range in this group was 20 to 40 years, and the average age was 27 years. The range of combat days was 150 to 800, and the average duration was 287 days.

The curve for these 30 ears (fig. 20) compares favorably with previous curves. The maximal dip is at 4096 cycles, and the threshold elevation is not significantly increased. When an additional group of patients was studied, the threshold curve for the 9 ears investigated (fig. 21) was not unlike the curve

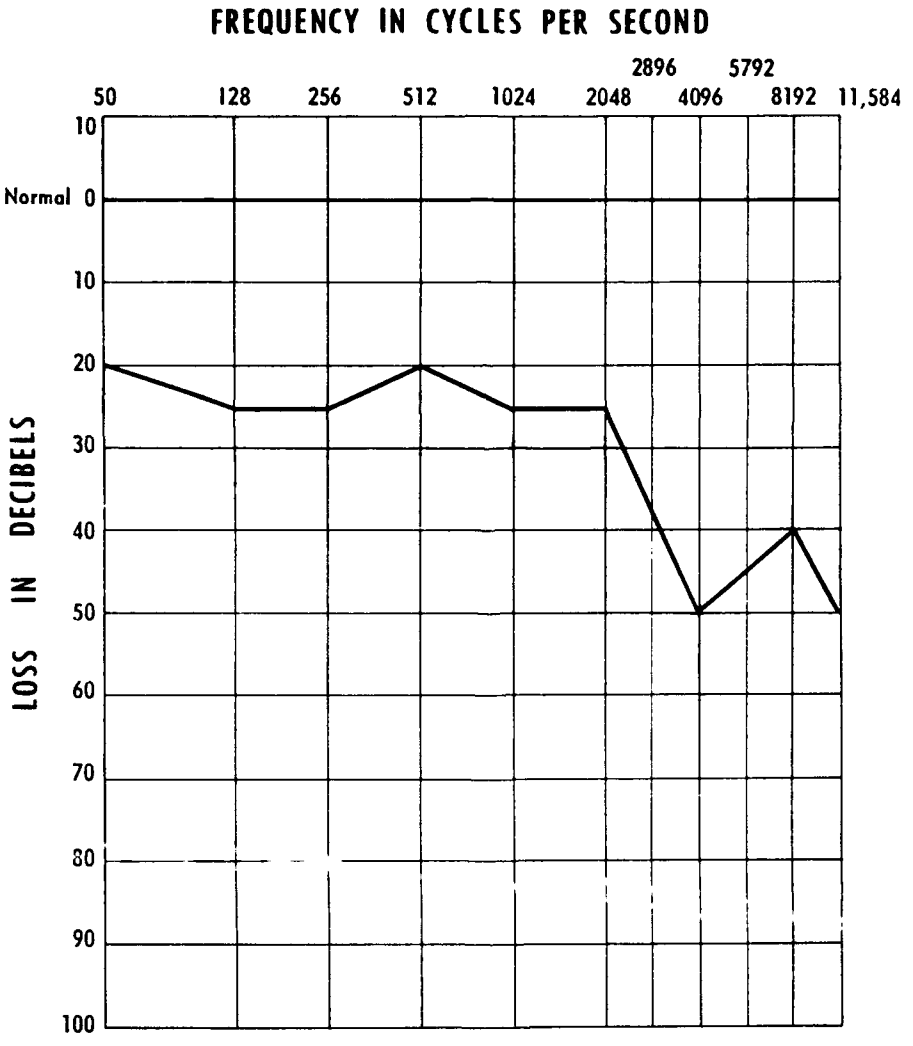


FIGURE 20.—Threshold audiometric curve of 30 ears belonging to combat-exposed patients who had no history of previous aural disease or of exposure to acoustic trauma in civilian life.

for the 30 ears (fig. 20) or the curve for other categories, though the dip at 4096 cycles represents an increase of 5 decibels. The age range in the group of additional patients (fig. 21) was 22 to 36 years, and the average age was 30 years. The combat days ranged between 365 and 900, and the average was 501. The number of ears studied in this category is so small that dogmatic statements would not be warranted, but the two curves (figs. 20 and 21) seem to suggest that an accumulative effect is not a factor in the production of acoustic trauma.

A review of these case records brought to light several interesting considerations. Patients who complained chiefly of tinnitus demonstrated, for the most part, a maximal threshold loss of 11,584 cycles. It was most unusual for a

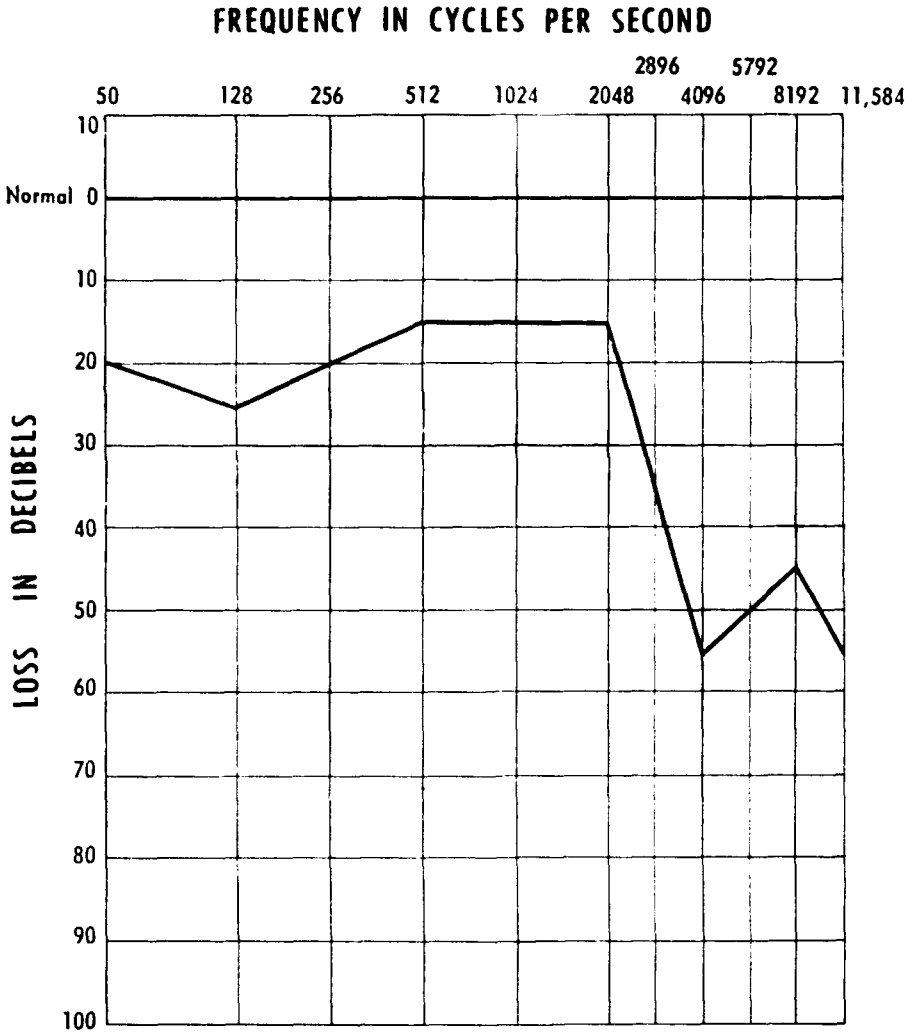


FIGURE 21. Threshold audiometric curve of 9 ears belonging to patients who had no previous history of discharge from the ear or of exposure to acoustic trauma.

patient in the tinnitus group to fail to demonstrate this frequency threshold elevation.

Patients suffering from concussion also presented a special pattern of curve. Some patients in the group presented complete loss of hearing. In others there was a generalized flattening of the curve from 512 to 2048 cycles.

FUNCTIONAL DEAFNESS

Since the intensity of fighting in World War II had no parallel in any previous war, it was not surprising to find a high incidence of combat exhaustion and a high incidence of functional deafness associated with this state. Patients whose deafness was on this basis presented, like patients with concussion, a threshold curve ranging from no response to the maximum-intensity output to a threshold loss of near-maximum intensity levels. The curve was generally flat.

Two types of functional deafness were encountered, the hysterical type and the simulated type of malingering (the so-called shellshock deafness of World War I). In the former variety, all clinical tests produced negative responses except the cold caloric test, in which the response was normal. In the latter variety, discrepancies could be demonstrated in the response to the usual tests for malingering. Stenger's test and its modification were helpful in the identification of soldiers who tried to avoid duty by simulating deafness. Not infrequently, however, it was possible for a patient to prepare himself against discovery, since the necessary policy of swift evacuation of casualties gave him the opportunity, as he was passed from hospital to hospital toward the rear, to become acquainted with every test commonly employed in the identification of malingerers.

To correct this impasse, a test referred to as the real-life test was developed for the identification of suspected malingerers. The patient was carefully observed for any mark of easy identification, such as unusual weight or height, visible scars, mannerisms, modes of dress, peculiarities of speech or gait, marks of arm of service, or any award or ribbon of special distinction. In the absence of such means of identification, the patient was told that his ear was to be treated and a piece of cotton, dyed some special color, was placed in it. Information concerning the identification of the patient was then given to the American Red Cross assistant field director attached to the hospital, who passed it on to other Red Cross personnel, with instructions to observe the patient casually. The circumstances for observation were ideal. The environment in the area assigned to the Red Cross was free of any evidence of challenge, and in it the soldier was relieved of any stigmata of war that might be found unpleasant. With Red Cross personnel, the soldier was among individuals with whom he felt at home and upon whom he desired to make a favorable impression. If he was malingering, he was likely to forget his alleged hearing impairment, to participate in competitive games and shows, and in general to behave in a

manner quite unlike that which he assumed before doctors, nurses, and ward attendants.

Red Cross personnel proved most helpful in the collection of data in cases of suspected malingering, and the real-life test was valuable in exposing patients who had astutely managed negative responses to tests for malingering ordinarily employed. The information obtained by this method was not found in error in any instance, and it several times indicated the avenue of correct therapy.

Psychiatric treatment chiefly consisted of effecting a release of pent-up emotions generated in battle, through the use of intravenous Sodium Amytal or thiopental sodium. After this treatment, the usual forms of individual and group therapy were employed. Anxieties, conflicts, and guilty feelings were thus released. By means of therapeutic measures and with the reassurance of the psychiatrist, the patient was enabled to regain his self-confidence and to reemploy his abilities in the war effort. The response to appropriate therapy was generally good, and a gratifyingly high proportion of patients could be returned to duty.

ETIOLOGIC FACTORS

The military duties of the patients in this series included, in the order of frequency, riflemen in the infantry, artillery men, personnel in armored units, machine gunners, combat engineers, ambulance drivers, truck drivers, runners, signal corpsmen, administrative personnel, and Medical Department personnel. There were also a few paratroopers and Army Air Force personnel, who were not as a rule seen at the 108th General Hospital. In civilian life, these men, in the order of frequency, had been laborers of all types, farmers and farmhands, clerks, small-business owners, technicians, electricians, cabinetmakers, carpenters, and students.

In order of frequency, traumatizing agents included high-explosive shells, mortar shells, mines, antitank rockets and armor-piercing shells, grenades (concussion), muzzle blasts (75-mm. tank gun), antipersonnel shells, aerial bombs, primacords, rifle fire, and rifle grenades.

The commonest experience of men wounded in action was a barrage. The expression "Shells were falling all around me" was the most frequent description of the events which immediately preceded the injury.

It will be observed (fig. 22) that, in the 64 of the 100 cases analyzed from the standpoint of the distance and location of the explosion in respect to the position of the soldier, the detonation occurred behind his position in only 10 instances. The increased frequency of the left and left-frontal detonating area was striking, as compared to the frequency of the right and right-frontal areas. The incidence of peripheral detonation (20 to 85 feet) productive of wounds was extremely low.

The pattern of the effect of detonating noise (fig. 22) can be explained only on the basis of the ability of the ear to perform its normal function of locating sound. The direction from which a sound is coming can be determined

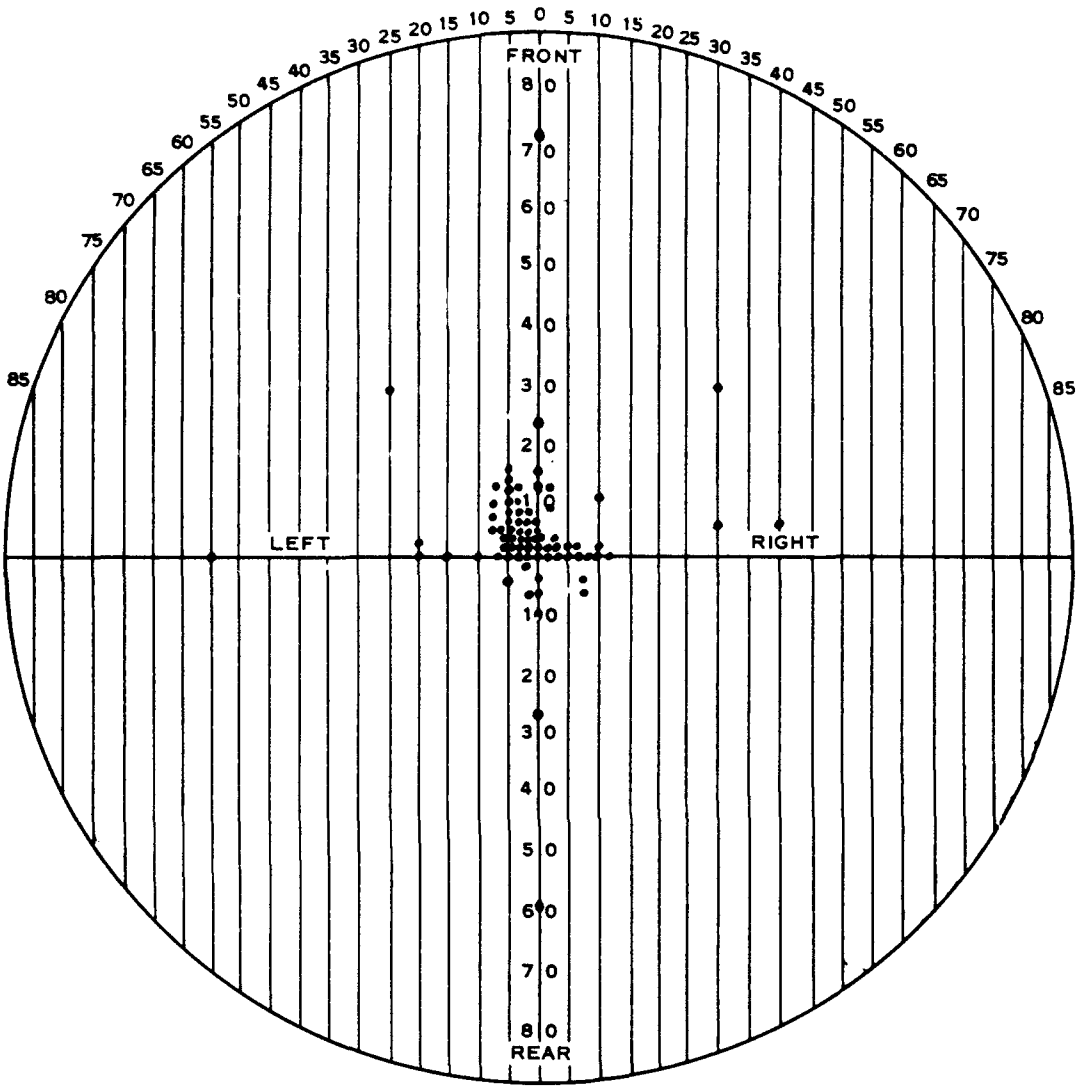


FIGURE 22. – Schematic representation of the distribution of shell, mine, and other explosions in 64 of the 100 casualties analyzed in terms of distance and location of the explosions. Note the high frequency in the left-frontal area. Note also the sporadic distribution observed outside the radius of 20 feet.

normally by its relative intensity in both ears and by the time of its arrival at both ears. Examination of the audiometric curve obtained in category II (fig. 16) of this series, which is part of the control group, suggests a tendency toward greater impairment in the left ear. Further study shows that this tendency was particularly notable in a selected group of riflemen, a class which furnished the highest incidence of casualties in this series.

The higher incidence of battle-incurred acoustic trauma in riflemen as well as the tendency toward greater impairment in the left ear than the right can be explained only theoretically. Assuming that the rifleman had the

habit of cocking his helmet to the right, he would create a situation in which, in addition to other battle trauma from noise, he would be exposed on the left side to the shock impulse created by his own weapon when he fired it. The traumatizing action of his own rifle fire would thus produce a state of temporary deafness in the left ear. The left-sided auditory impairment would further predispose him to wounds from left-sided explosions, as a direct result of his failure to appreciate the approach of missiles from that side. Certainly the ability of artillery to "zero in" on a target would not be unilateral; equal numbers of shells probably would fall to the right and to the left of the midline. The absence of temporary deafness in the right ear, however, which would imply its full function, would enable the soldier to avoid injury from shellfire on that side by taking cover in adequate time, while temporary deafness on the left side would prevent his protecting himself from similar injury on the left side.[3]

Further support for this supposition is provided by the fact that 36 men in this series could give no description of the location or direction of the explosion in which they were injured. The most frequent source of injury, as has been pointed out, was artillery barrage. There is also the possibility, in addition to other factors, that the men who could give no description of the direction, distance, or location of the explosion had been deafened previous to the period at which they were wounded. On the other hand, still another possibility must be considered—that the detonation had taken place beyond the frequency-of-hearing range.

The auditory sensation from the subjective experience was not infrequently described in extremely vague terms, such as "a whoosh," "a rush of air," and "a hell of a blast." Many men replied to the question, "What did it sound like?" by saying, "I think I heard the explosion, but I can't describe it."

OTOSCOPIC AND CLINICAL OBSERVATIONS

The most common finding on otoscopy was a normal or almost normal eardrum. Frequently, the injury was so slight that it would have been missed except for the routine use of the Siegle otoscope. All gradations of trauma were observed, from moderate injury of the drum, manifested by slight and localized interstitial hemorrhage, to complete destruction of the tympanum. Some perforations were so slight that they were identified only after the air the patient described as "coming out of my ear when I blow my nose" had been objectively established by an auscultation tube.

Although most perforations had sharp, irregular edges, in the slight cases just mentioned the perforation had the appearance of a rent and was frequently located antero-inferiorly, at the junction of the tympanum and the wall of the canal. In the small-hole type of perforation, the location was most often

[3] Similarly, a sniper slinking in the darkness might be undetected by a soldier with a temporarily deafened left ear, while a similar acoustic stimulus on the intact right side would cause him to take cover.

anterior to the malleus. In small, multiple perforations, the openings were not uncommonly in front of and behind the malleus, on a level with the umbo, halfway between it and the annulus, toward 3 and 9 o'clock. Larger perforations were likely to be kidney shaped, with the lesser curvature directed parallel to the annulus, a few millimeters distant from the periphery of the drum. Larger perforations were frequently associated with casts of clotted blood which extended into the auditory canal. A discharge was uncommon, and only occasionally was a well-developed acute suppurative otitis media observed.

In the 100 category I patients, perforation was observed in 73 (36.7 percent) of the 199 ears studied (fig. 13). From the standpoint of the category IA and IB groups, perforation occurred in 67 of the 147 ears to which complaints were referred (45.6 percent), but in only 6 of the 52 ears in which objective findings of injury were not associated with complaints (11.5 percent).

An effort was usually made to ascertain possible forces acting on the eardrum to produce perforation. In many instances, small pellets of soil, fragments of brick and stone, and other foreign material were found. Such material, however, was also found in cases in which there was no clinical evidence of trauma to the drum.

Rupture of the eardrum was observed in cases in which there were present slight to moderately large impactions of cerumen. The presence of complete obstruction to the canal by a cerumen cast might or might not exclude the occurrence of a perforation of the drum. This is a somewhat anomalous situation, since it has already been reported that perforating wounds of the eardrum have been observed in soldiers with "moderately large" cerumen deposits in the canal. Whether total closure of the canal by a cerumen impaction affords adequate defense against perforation is debatable, though it is possible that the impaction might defend the drum from the longer lasting negative action of the shock wave.

Examination of the edges of large perforations revealed interesting findings. By the introduction into the middle ear, through the perforation, of a curved attic cannula irrigation needle and its use as a suction tip, it was possible to draw into it irregular, triangular, tonguelike bits attached to the periphery of the perforated drum. The possible explanation of the inwardly placed drum remnants is probably the conical shape of the drum, which permitted them to fall in this direction. The possibility exists, however, that the drum was rent by the short but intense positive wave of the shock pulse, which drove the tissues of the drum inward at this time. Further investigations directed along this line have not yet been reported.

It was not possible in this study to form any judgment combining the degree of hearing impairment associated with various types of objective damage to the tympanic membrane or related structures of the ear which had been exposed to the influence of the shock pulse. As has been pointed out, perforating wounds of the eardrum were sometimes present when the patient was ignorant of their existence, and normal auditory acuity was sometimes demon-

strated in cases in which the shock pulse had been sufficiently violent to rend the eardrum. In the main, no direct correlation could be made between the amount of hearing loss and the amount of traumatic injury to the conductive mechanism. It may be that when more reliable information can be obtained a more accurate evaluation of hearing loss and a more accurate prognosis can be made in terms of the explosion producing the damage and the distance of the casualty from the explosion.

An interesting observation in this series was the absence of complaints indicative of injury to the receptors of dynamic and static equilibrium. The possibility must be taken into consideration that the semicircular canals, the utricle and the saccule, are protected by their anatomic location in the temporal bone and that the infrequent complaint of dizziness can be explained on this basis. On the other hand, the cochlear portion of the labyrinth is exposed to the direct effects of blast by way of the oval and round windows and the promontory. One patient in this series had a fracture of the promontory and was totally deaf but did not complain of dizziness.

Another possible explanation of the absence of complaints of dizziness is the masking effect of other wounds, as well as the patient's sharper interest in his hearing impairment than in other symptoms.

Diplacusis was not a complaint in any case in the series, and for this unexpected situation there is no logical explanation.

THERAPY

Treatment of battle-incurred acoustic trauma was limited to removal of clots by suction, by means of a suitable metal suction cannula. If gentle suction was not successful, no further effort was made to remove an uninfected clot which was resistant. Applicators, hooks and other instruments, and eardrops and irrigations were never employed. If the middle ear was dry, either no treatment was instituted or a sterile cotton pledget was placed in the canal. Penicillin-sulfathiazole powder was occasionally employed in cases which did not respond to the expectant routine. The number of patients thus treated was too small and the period of observation was too brief to permit conclusions, but the impression was that this agent was of value.

COMMENT

The anatomy and physiology of the ear must be borne in mind in discussing battle-incurred acoustic trauma. The suspension of the ossicles by the fan-shaped ligament of the incus and the anterior ligament of the malleus reduces the small mass of the drum and ossicular chain (0.05 gm.) to an insignificant factor. The efficiency of this mechanism is indicated by the ability of the ear to follow vibrations ranging in speed from one-twentieth of a second to one twenty-thousandth of a second. Its sensitivity is exemplified by the sense of sound experienced objectively when the malleus is displaced through an ampli-

tude less than the diameter of a hydrogen molecule upon stimulation by a 3000-cycle wave.

The integrity of the structures of the ear is a dominant factor in the conduction of sound. A hearing impairment is to be anticipated if the destructive power of the shock pulse acts directly upon these vulnerable tissues. If such a shock pulse acts directly upon the conductive elements of the ear by way of the external auditory canal, a condition is brought about that would focalize the energy of impact to a relatively small area. The drum, which is placed between two air chambers with normally equal pressure, might be uninjured by the propagation of the shock pulse through the canal, but a different reaction must be expected in the middle ear spaces, from which locked-in gases are not easily discharged. Since the gases cannot escape by way of the relatively closed eustachian tube, they are displaced to other parts of the middle ear, and it is possible that the destructive effect of the shock pulse may thus be directed to the cochlea by way of the oval and round windows. Trauma to the organ of Corti is therefore produced as a direct result of the violence of the shock pulse.

The threshold elevation observed in this series at or near 4000 cycles has long been known to occur in boilermakers' deafness, and a similar "aviator's notch" has been reported in personnel exposed to the noise of airplanes. Such terms as "tonal dip," "high-frequency loss," and "4096 dip" have been employed to describe it. It would be well to standardize the nomenclature, since it is evident that exposure to loud sounds from any source tends to produce the maximum hearing loss around 4000 to 6000 cycles, the depth of the depression of the dip bearing a relationship to the intensity of the source rather than to the agency from which the sound originates. Acoustic interval and acoustic scotoma are offered as possible terms to describe the tonal dip at 4096 cycles for which a standardized expression is now lacking.

There is still no adequate explanation for the tonal dip at 4096 cycles in combat-incurred acoustic damage. Since the duration, intensity, and frequency of the traumatizing force responsible for the cases in this series are not known, this study throws no light upon the question. Studies by other observers indicate that the 4096 dip can be induced experimentally by exposure to a 2048-cycle fatiguing tone and that the maximum dip occurs an octave above the fatiguing tone in the high frequencies.

A number of questions are raised by the observation in this series that a maximum tonal dip occurs at 4096 cycles in auditory impairment originating in battle trauma. Does all noise of combat possess a similar tone quality? Does the helmet or tank, when hit by enemy fire, set into motion metal bodies capable of vibration, and is there a resultant source of acoustic trauma from the vibrating helmet or tank? Many riflemen described the sound of a bullet against a helmet as a "ping" or high-pitched crack, while the tankman described his auditory sensation as resembling a bell or a gong. Do the supersonic frequencies outside the hearing range contain harmonics related to the tonal dip at 4096 cycles? What is the relationship of the latency period to acoustic trauma?

What is the effect of high-frequency sound waves reflected from metal surfaces during the latency period; that is, meter-beat effect? Clinical, experimental, and histopathologic investigation is necessary to settle these and other questions, and there must be additional investigation concerning the influence of the pulse wave on the auditory apparatus in the production of the phenomenon of auditory impairment due to acoustic trauma.

It should not be construed, from anything previously said, that audiometric testing furnishes an infallible means of diagnosing acoustic trauma or that every soldier whose auditory apparatus was exposed to the effects of blast necessarily presented a tonal dip at 4096 cycles. It cannot be assumed, moreover, that a threshold increase for 4096 cycles indicates only combat-incurred acoustic injury. On the other hand, an analysis of the audiometric patterns secured in this series shows that in the majority of cases the curves are characteristic. The conclusion is therefore warranted that a diagnosis of combat-incurred acoustic trauma can be made in a large proportion of combatant personnel by a routine history, a careful physical and psychiatric survey, and the application of audiometric testing.

Audiometric testing is of great importance to the Army otologist who is confronted with the obligation of supplying proper care to blast-exposed patients who come under his observation. The triage of these cases would have been difficult without established criteria, which permitted the separation of patients into (1) those with adequate hearing, who could be promptly returned to duty; and (2) those who had to be retained for observation, treatment, and reclassification and reassignment to limited duty in the event that the hearing impairment was such as to make the man in question a liability to his outfit. The otologist's primary duty was to support the principal function of the Army, that is, combat, and to return to full duty as many casualties as possible. Audiometric testing put diagnosis, treatment, and disposition on a sound scientific basis and salvaged a great number of men for combat duty.

SUMMARY AND CONCLUSIONS

1. Combat personnel exposed to the effects of combat acoustic trauma demonstrated a tonal dip maximal at 4096 cycles when tested in a soundproofed room with a standardized audiometer.

2. Combat-incurred aural injury, as manifested by a tonal dip, could be recognized before the speech frequency range was affected. Application of this knowledge proved to be a satisfactory basis for classification and ultimate disposition of soldiers seen by the otologist.

3. No correlation was found between the degree of objective injuries to the eardrum and the degree of auditory impairment.

4. No evidence was found that would indicate a cumulative factor in acoustic trauma.

5. Ears which were the site of auditory impairment before military service proved as vulnerable as normal ears to the noise of combat.

6. Temporary deafness of the left ear, caused by the muzzle blast from the soldier's own rifle, appeared to predispose to combat injuries from explosions occurring on the left side.

7. Aural battle casualties presented a paucity of complaints referable to the receptors for equilibrium, and complaints of diplacusis were even more infrequent. Deafness was commonly associated with tinnitus; in such cases, only the maximum threshold elevation was at 11,584 cycles.

8. Hysterical and simulated deafness was not uncommon. A method of detection of malingerers, termed the "real-life" test, proved more valuable than the usual clinical test for malingering. Both varieties of deafness responded well to proper identification and treatment.

9. The evidence of this study suggests that acoustic trauma was a matter of great importance in the ground forces in World War II. They were not adequately protected against it, and, in the future, measures should be taken to furnish such protection.[6]

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[6] During 1944, an acrylic anticoncussion device, developed by a dental officer, Third U. S. Army, was constructed with the enthusiastic approval of Col. James J. Weeks, DC, (deceased), then Dental Surgeon, Third U. S. Army. Approximately 1,700 of these devices were fabricated by dental personnel and used before 1 May 1945 by Third U. S. Army gunerews of field-artillery battalions (155 mm). These soldiers found the device to be extremely beneficial. It largely eliminated concussion effects and greatly reduced fatigue, yet it did not impair the degree of hearing required to use the telephone or carry on a normal conversation. Unfortunately, the efficacy of this device, which was carried by the soldier to be inserted in the ear when needed, was limited to conditions such as were encountered by gunerews who operate under an orderly process of command and action. It did not solve the problem of the soldier in the field, who required a hearing acuity above the normal conversational level or who was suddenly caught in a barrage. Furthermore, the device was a potential source of infection and an additional foreign body in the ear in the event of a head injury. The deficiencies inherent in a device which is effective only under limited conditions thus emphasize the need for continued research for an overall preventive measure to insure against auditory damage due to acoustic trauma.—J. B. C., Jr.

CHAPTER VI

Unrecognized Auditory Trauma From Battle Noise

Gordon D. Hoople, M. D., William C. Wolfe, M. D., and Samuel C. Bregande, M. D.

Because World War II was perhaps the noisiest war in history, otolaryngologists necessarily interested themselves in the effects of battle noise on the ears of exposed soldiers. Battle noise, it should be emphasized, was not necessarily combat connected. It is probable that as much blast or noise is experienced on an artillery range during training periods as in actual battle. Certainly, quite as much was experienced during the training program in World War II as on the battlefield.

Critical loss of hearing accompanying such lesions as ruptured membrana tympani, hemotympanum, and intracranial injuries was obvious and could not be overlooked. Early in the war, however, it became evident that hearing losses were occurring in soldiers in whom the results of exposure were less obvious and who, as a matter of fact, sometimes were not aware that impairment of hearing had occurred. The study reported in this chapter was undertaken to determine the nature and incidence of this type of hearing impairment.

MATERIALS AND METHODS

Audiometric studies to determine the nature and degree of unsuspected hearing impairment following combat were made at the 52d and 55th General Hospitals in England on 1,200 soldiers who were casualties of the invasion of northern France and subsequent battles, but who had no auditory complaints and whose hearing by their own testimony was normal. The selection was entirely at random except that psychiatric subjects were naturally excluded.

The control series consisted of 100 soldiers from one of the hospitals mentioned and 50 soldiers from the other. These men were selected from detachments permanently assigned to the hospital staff. They had had no exposure to combat and had no subjective hearing loss. Men with a previous history of ear disease were included in the control group if their hearing was apparently normal. Some of those selected for study were found to have varying degrees of hearing loss, of which they were unaware, but they were kept in the control series; it was considered that they furnished a group comparable to the soldiers

included in the battle-exposed group who were found to have hearing losses of which they too were unaware.

The effort to determine the duration and degree of exposure to battle noise was found to be impractical. Had an accurate determination of these points been possible, much might have been added to present knowledge of the effects of noise on the ear, but it soon became evident that individual soldiers could not accurately compare the intensity of noise in one locality with its intensity in another. What one man would exaggerate, another would minimize.

An attempt to determine the characteristics of the final type of exposure also proved without value. Many of the men had no idea of the kind of explosive to which they had been exposed. Many had been wounded by rifle bullets in periods of comparative quiet, after several days of intense noise. Some were hospitalized for such conditions as trenchfoot, after periods of exposure to noise. The general tendency of men questioned in detail on this point was to say "88," this being the gun which soldiers in general regarded as the root of all battle evil. The unsatisfactory results of this particular inquiry supply further evidence of the unreliability of detailed histories obtained from soldiers concerning the events of combat in which they have participated.

Although a large number of the 1,200 soldiers studied complained of tinnitus, detailed questioning concerning this sympton was deliberately slighted in the endeavor to avoid a fixation in this regard. No record of the number registering this complaint was kept, but there is no doubt that, when tinnitus was present, audiometric loss of some significance was usually demonstrable.

The records of 1,000 of the 1,200 soldiers who had been exposed to battle noise were studied in detail, the number being selected arbitrarily to simplify the calculation of percentages and averages, a matter of no small concern in a study conducted in time of war. A reasonably careful history was taken on each of these soldiers, and they were categorized according to the prominent events of their stories. In the light of certain of the data obtained, further questioning would probably have permitted additionally informative categories, but the rush of caring for critically wounded men during heavy fighting precluded a more intensive study.

The 1,000 soldiers studied in detail were analyzed, as indicated, in the following categories:

A. *Age.*—On the basis of whether they were over or under 30 years of age.

B. *Status of the eardrum.*—On the basis of whether the drums were normal or presented evidence of adhesive lesions of the middle ear.

C. *Date of exposure.*—On the basis of whether exposure occurred before or after 1 October 1944.

D. *Branch of service.*—On the basis of whether the soldiers were infantrymen or were members of armored divisions.

E. *Hearing loss.*—On the basis of whether hearing loss was more or less than 30 decibels in each of the 10 frequencies tested.

RESULTS

The composite audiogram of the 150 soldiers who had no known loss of hearing and who had not been exposed to battle noise (fig. 23) is to be compared with the similar audiogram of 1,200 battle-exposed soldiers who also had no known loss of hearing (fig. 24). The average age of each group was 26 years. The composite audiogram of the soldiers who were exposed to battle noise showed some loss throughout the entire range, with the characteristic loss of high tones beginning at the 2896 level. A number of the soldiers studied stated that they had suffered temporary hearing losses at some time during their exposures, but all maintained that the impairment had completely disappeared

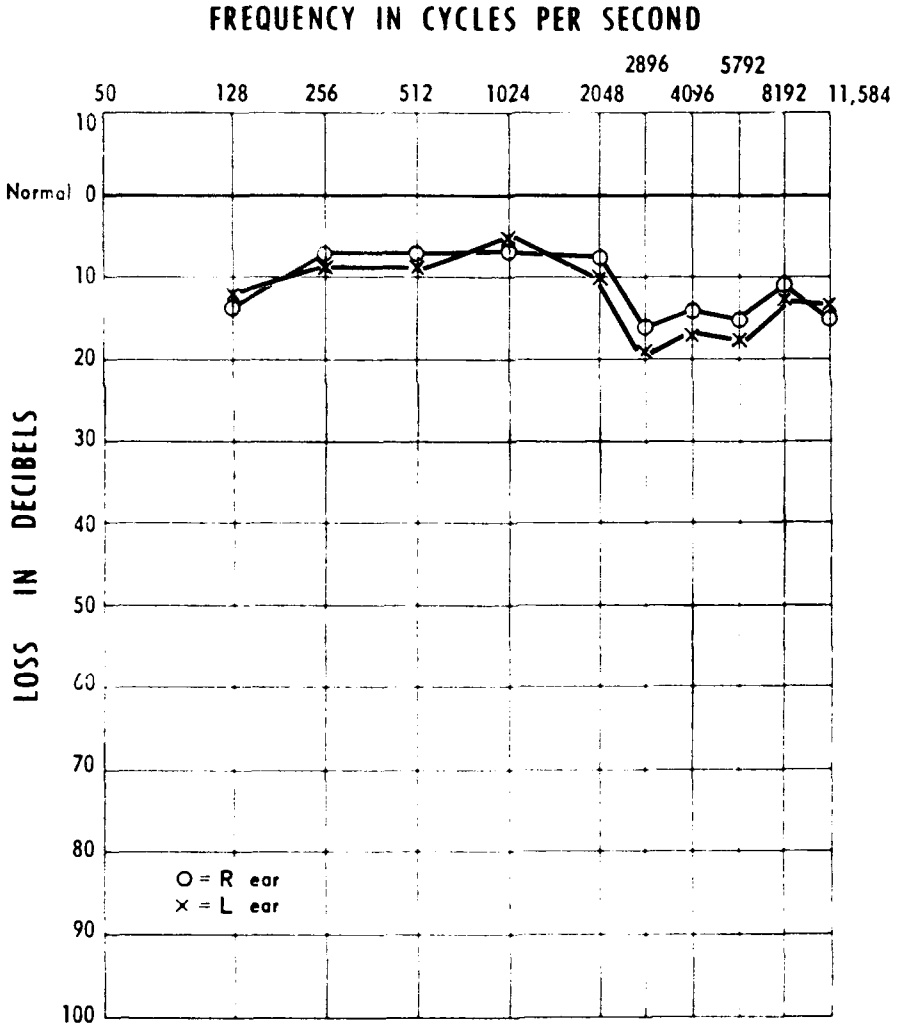


FIGURE 23.—Composite audiogram of 150 soldiers, with an average age of 26 years, who were not exposed to battle noise and who had no known loss of hearing.

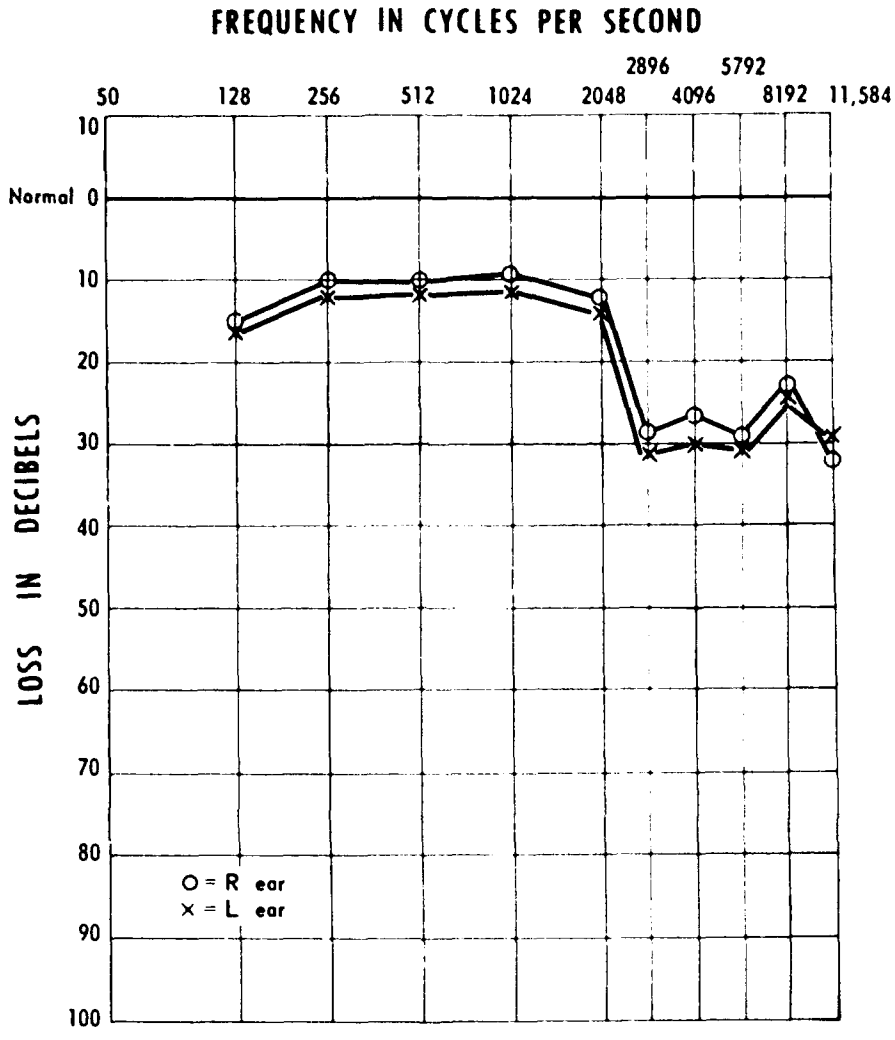


FIGURE 24. Composite audiogram of 1,200 soldiers, with an average age of 26 years, who were exposed to battle noise.

by the time of the examination. In most instances, the loss was stated to be the result of a loud explosion, usually coincidental with the injury which had caused hospitalization. One hundred and sixty-two patients localized the noise responsible for the hearing loss on the right side and one hundred and fifty-eight on the left side, but, in a large proportion of the cases, audiometric study failed to show a higher percentage of auditory impairment on the side on which the explosion was supposed to have occurred.

Age (Category A)

Of the 1,000 soldiers studied in detail, 210 were 30 years of age or older and the remainder were under 30. Those over 30 years of age were on the

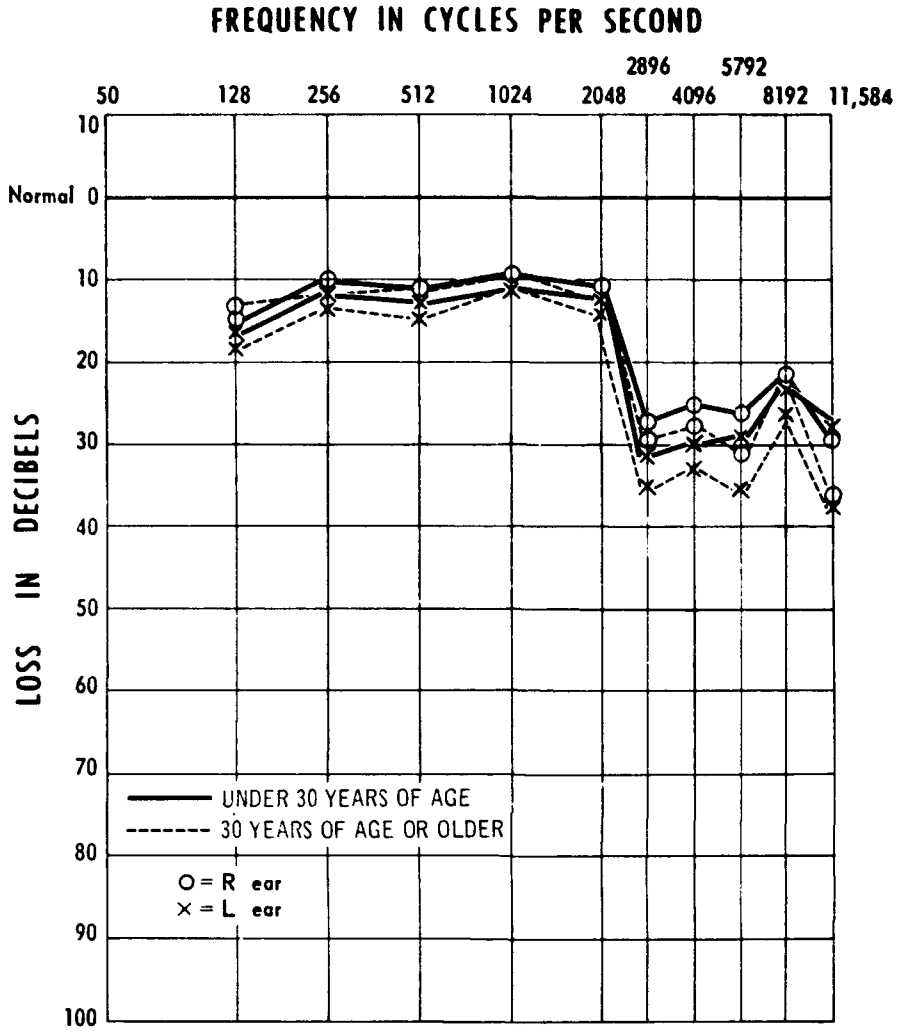


FIGURE 25.—Composite audiogram of 1,000 battle-exposed soldiers classified according to whether they were under or over 30 years of age.

average about 10 years older than those under 30. The difference in the audiometric readings for the two groups (fig. 25) is not significant and furnishes no clear-cut evidence that a soldier over 30 is liable to greater audiometric injury in battle than a soldier under that age. The disparity in the audiograms of the two age groups is so slight that it can reasonably be attributed to the disparity in age between them.

Status of Eardrums (Category B)

The eardrums in this series, which were studied by means of Siegle's otoscope, were divided into those which showed normal motility and those in which motion was restricted. In the latter group, suggestive evidence was obtained that previous inflammatory lesions of the middle ear had resulted in

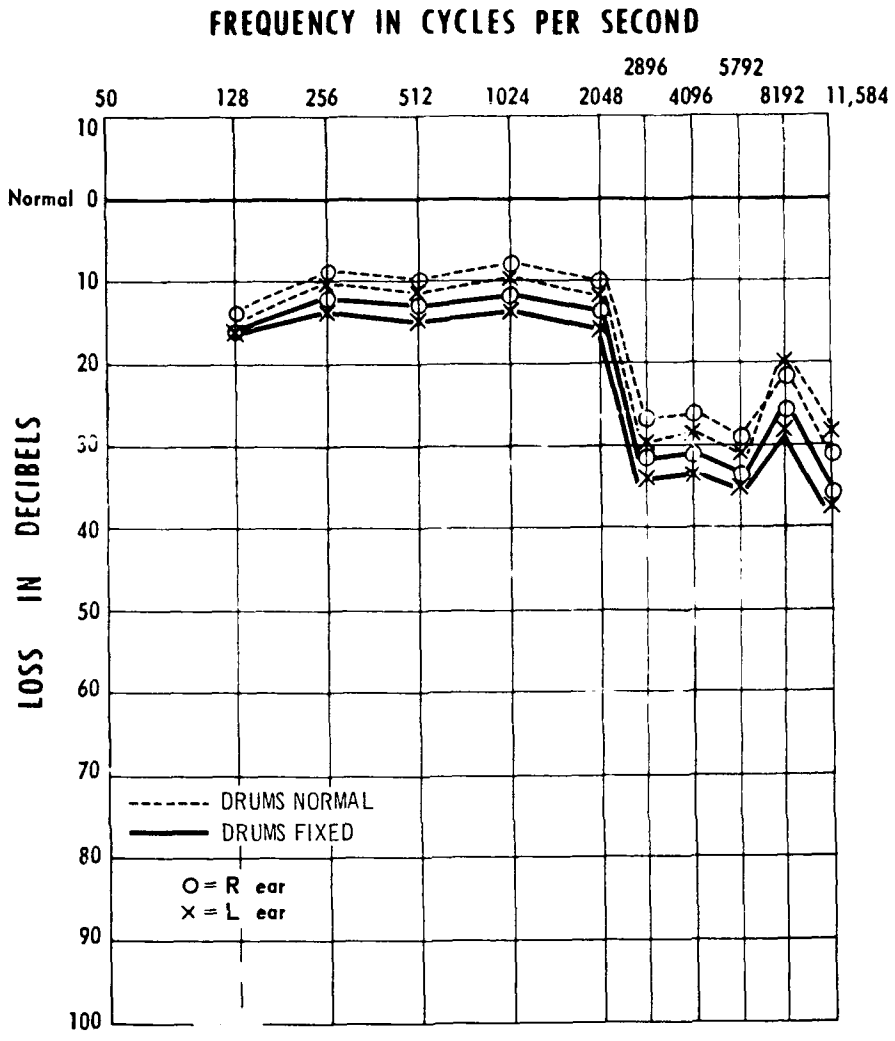


FIGURE 26.—Composite audiogram of 1,000 battle-exposed soldiers classified according to whether their eardrums were normal (783 on the right side and 790 on the left) or were fixed (217 on the right side and 210 on the left).

adhesions, and the purpose of this particular phase of the investigation was to ascertain what effect, if any, such adhesions might have upon the transmission of more than normal sound waves.

Two hundred and seventeen drums on the right side were found to be fixed, as were two hundred and ten on the left (fig. 26). The difference in auditory acuity between men with normal and men with abnormal drums was appreciable but not significant. Whether or not previous middle ear disease makes a soldier more susceptible to auditory trauma than a soldier with a normal eardrum cannot be established by these figures.

During the course of the war, numerous examinations were carried out on men with eardrums grossly distorted by previous disease who had known

hearing losses of varying degrees before exposure to battle noise. Although these soldiers met the minimal requirements for service, they were not included in this series. Audiograms were made, however, of all who had had audiograms in service or elsewhere before combat. It would have been of interest to compare the early audiograms with those made after combat, but this, unfortunately, did not prove possible.

Date of Exposure (Category C)

Categorization according to date (before and after 1 October 1944) was carried out because there was apparently greater concentration of gunfire in the earlier stages of the European invasion than in the later months. No significant difference was apparent between the two groups (fig. 27) and prob-

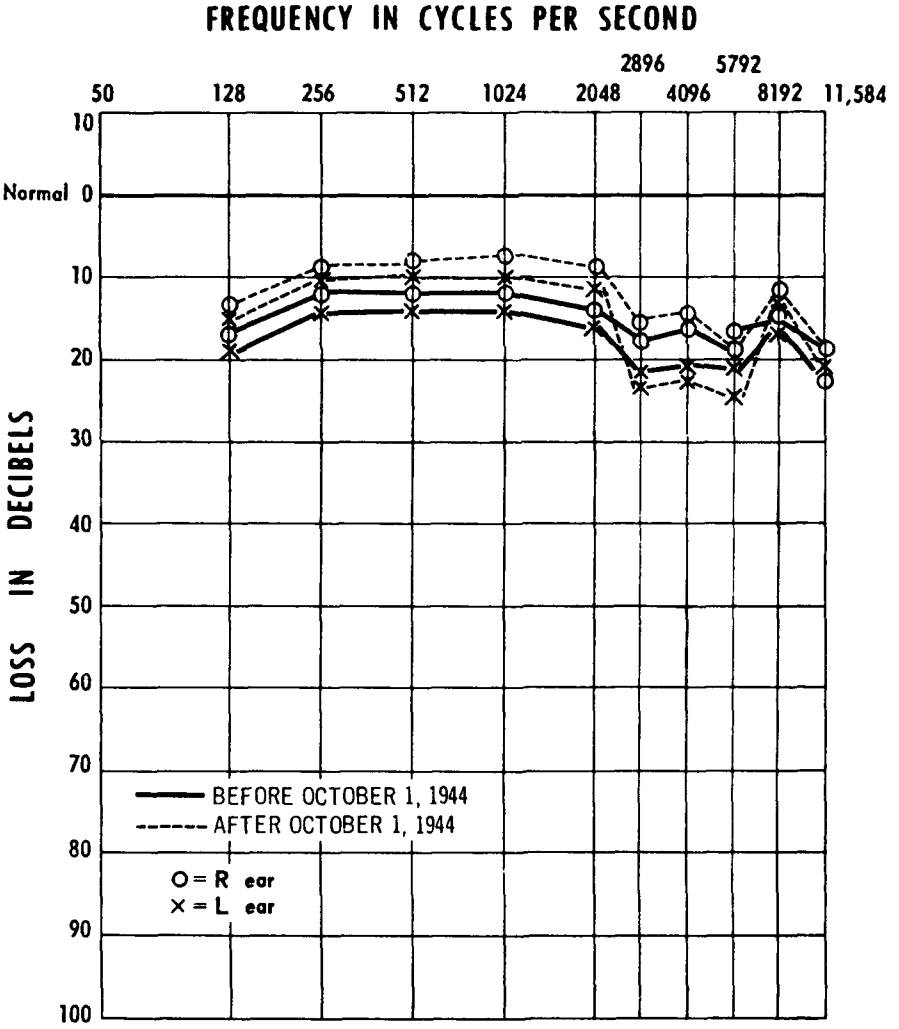


FIGURE 27.— Composite audiogram of 1,000 battle-exposed soldiers classified according to whether exposure occurred before or after 1 October 1944.

ably should not have been expected. The cochlear damage sustained in battle was the result of an extremely intense noise of short duration rather than of a prolonged noise of lesser intensity. It was repeatedly observed that a single shell falling near a soldier in a relatively quiet sector could cause more hearing loss than many shells falling in battle if none of them fell in close proximity.

Branch of Service (Category D)

Categorization of the 1,000 soldiers according to whether they belonged to the infantry or to armored divisions seemed warranted, the assumption being that, because of their own fire power and their exposed, advanced positions, armored forces would be subjected to greater battle noise. Actually, audiometric testing (fig. 28) showed slightly greater loss in the infantrymen.

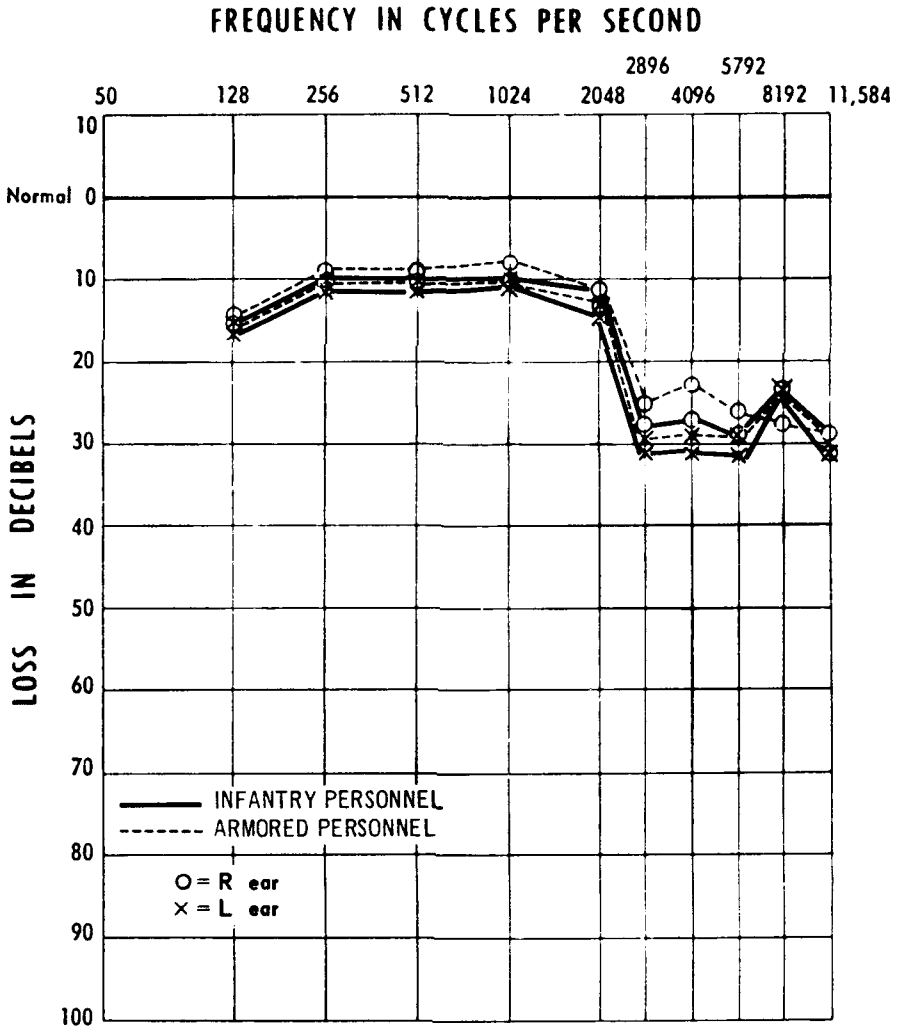


FIGURE 28. Composite audiogram of 1,000 battle-exposed soldiers classified according to branch of service (784, infantry; 216, armored divisions).

The results naturally raised the question whether the headgear of armored troops, which consisted of football-type helmets with earflaps, as well as their earphones, did not provide a certain amount of protection to hearing. Be this as it may, the results of this particular phase of the investigation seemed further to substantiate the old Army adage that the infantry always takes the brunt of battle.

Hearing Loss (Category E)

Of the 1,000 soldiers studied in detail, 300 were found to have hearing losses of less than 30 decibels in both ears in each of the 10 frequencies tested. Of 100 normal controls studied intensively, 70 fell into this group. The composite audiometric curve of the combat group just described (fig. 29)

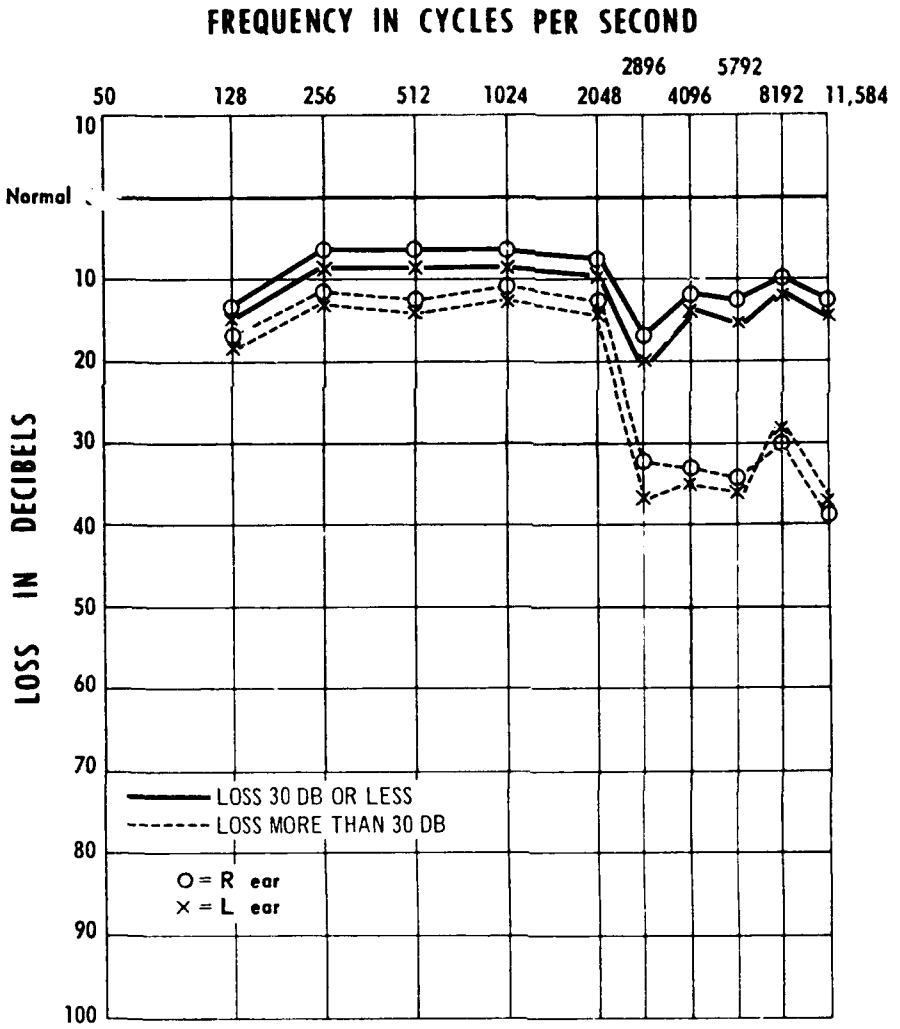


FIGURE 29.—Composite audiogram of 1,000 battle-exposed soldiers classified according to whether hearing loss was less than 30 decibels, or more than 30 decibels in at least one frequency.

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approximated the curve of the noncombat group (fig. 23). The remaining 700 of the 1,000 soldiers studied showed hearing losses of more than 30 decibels in one or more of the frequencies tested (fig. 29), the 70 percent prevalence of hearing impairment, due to combat, in the battle-exposed group thus being 40 points higher than the 30 percent prevalence of hearing impairment in the group not exposed to battle noise.

The possible difficulties which may arise in the absence of knowledge of preinduction auditory disability are well illustrated by the story of a high-ranking officer who appeared in the otolaryngologic clinic of a general hospital complaining of hearing loss sustained as the result of exposure to battle fire at the Remagen bridgehead. His audiometric curve, which was typical of the curve of any severely exposed individual, showed hearing loss in the low as well as the high frequencies. He had marked loss of hearing for speech. An award of the Purple Heart was made, but, when the notification was sent to his commanding officer, it was questioned on the ground that the patient had a known severe hearing loss before his entrance into battle. Investigation revealed the existence of a preexposure audiogram, which proved almost identical with the postexposure graph. Without the preexposure audiogram, which does not usually exist, this soldier would almost certainly have been judged a battle casualty by any otologist. This situation is typical of the problem which faced many military otologists when they had to make decisions with pertinent evidence lacking.

COMMENT

It is recognized that the classification of soldiers on the basis of whether their hearing impairment was more or less than 30 decibels in any of 10 frequencies is both arbitrary and artificial, but some such separation was necessary to reach an approximation of the number whose ears had been affected by battle noise since apparently not all who had been exposed had had resulting acoustic trauma. The results of the study suggest that an appreciable number who had been exposed had reacted with a demonstrable degree of acoustic trauma. The incidence of auditory impairment was set at the round figure of 40 percent, this being the difference between the incidence (70 percent) recorded in the combat group and the incidence (30 percent) recorded in the noncombat group. No more positive figure can be established, since preexposure audiograms were not available, but the fact that such a large number of men were tested makes the statement permissible. It would also be impossible, in view of the fact that approximately 30 percent of the soldiers in the United States Army apparently had an appreciable degree of audiometric loss before entering combat, to state that any particular soldier had or had not been the victim of acoustic trauma from battle noise unless a precombat audiogram was available.

Exactly what significance should be placed upon the results of this study it is difficult to state at this time. Included in the group of 1,200 soldiers were men with appreciable acoustic trauma, slight though it might be. In none of them, so far as the soldier himself was aware, did the trauma reach a recognizable level. None were told of the loss, for two reasons: In no instance did the impairment fall within the scope of Army regulations, and in no instance was it possible to tell whether the loss had existed before exposure to trauma during combat. It can be assumed, however, that in some instances the auditory impairment was battle incurred.

What effect this impairment will have on the hearing of these men 5, 10, 30, or 40 years hence is a matter which cannot be ignored. It may make no difference. It may, however, speed the normal decade-by-decade advance to such a degree that handicaps in the speech frequencies will be reached sooner than would ordinarily be expected. Lederer's [1] studies with acoustically handicapped sailors at the Philadelphia Naval Hospital suggest that cochlear degeneration is progressive. Audiograms taken a year after trauma was sustained showed a greater degree of loss than the audiograms taken just after the initial edema and reaction had subsided. His patients had sustained gross changes, but the question arises whether patients with minimal changes would show the same progressive tendency. In this connection, it would have been most valuable if a study of a cross section of the 1,200 soldiers discussed in this chapter had been made 5 years after they had sustained their trauma.

The scores of soldiers with severe acoustic damage examined at the 52d and 55th General Hospitals are outside the scope of this study. Many of these men undoubtedly were evacuated to one or another of the aural-rehabilitation centers in the Zone of Interior and thus participated in a rehabilitation program which was efficient and effective. Between these individuals, who were fortunate in the sense that they received adequate care, and individuals with such minimal damage as has been described in this chapter were others, probably thousands, with varying degrees of cochlear damage who in future years will be a problem to themselves, to society, and to the otologists of the country. Most of this group never reported their handicap to the medical authorities. Some did not realize that it existed. Some did not want to complain of what they considered a natural sequela of their war experience. Some believed that the difficulty was an ailment from which they would recover in the course of time. Some did not complain because they feared that an investigation of their hearing would postpone the discharge from the Army, which they expected and looked forward to. Whatever the cause, these men were not identified while they were in service, and it is doubtful that all of them will ever be identified. The size of the problem created by battle noise will therefore never be fully known.

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[1] Lederer, F. L.: Personal communication.

There is another reason why this problem will never be fully solved. During World War II, preinduction tests of hearing acuity were limited first to the spoken-voice test and later to the whisper test. The inadequacy of both procedures is well known to otologists. The present study suggests that there must be, among the soliders who were in combat in that war, a relatively large group of men with varying degrees of undiscovered or unrecorded trauma from battle noise. Lacking the evidence necessary, however, to establish preinduction disability, it will never be possible to know the full extent or the actual seriousness of the problem of the acoustically handicapped of World War II.

The large proportion of men revealed by this study to have some auditory impairment, a certain proportion of which was undoubtedly battle incurred, suggests the serious necessity of providing, against the possibility of future wars, some effective and inclusive measures against hearing loss. During World War II, soldiers were not thus protected. The pace of destructive warfare was enormously increased between the First and the Second World Wars, and it is doubtful that protection will ever overtake the means of destruction, but the evidence in this study indicates the necessity for continued attempts to do so.

CHAPTER VII

Facial Paralysis in Military Personnel

Frank D. Lathrop, M. D.

HISTORICAL NOTE

In the First World War,[1] facial paralyses occurring as a result of battle wounds were treated either by anastomotic operations between the distal end of the facial nerve and the central end of an adjacent motor nerve or by various plastic procedures designed to minimize the asymmetry of the face. Both methods of treatment left much room for improvement.

In 1922, Ney [2] pointed out that "the only hope of restoring bilaterally coordinated emotional expression after a paralysis of the facial nerve lies in the restoration of the functional integrity of that nerve." At the same time, he described a method by which primary suture of the divided ends of the facial nerve could be accomplished when the defect in the nerve was not more than 1 centimeter. In the event of a greater loss of substance, he recommended the use of the sensory portion of the radial nerve as a graft. In 1925, Bunnell [3] accomplished the first intratemporal repair of a traumatized facial nerve by primary suture. In 1930, Bunnell and, in 1931, Ballance and Duell,[4] utilized nerve grafts to restore the function of the facial nerve, thus establishing the feasibility of Ney's earlier suggestion. Since that time, the practicability of these methods of treating traumatic facial-nerve palsy has been confirmed by numerous surgeons.

POLICIES IN WORLD WAR II

Early in the course of World War II, centers were established for the treatment of casualties with problems peculiar to orthopedic surgery, neurosurgery, maxillofacial and plastic surgery, neuropsychiatry, and impairment of sight and hearing. It was not until considerably later in the war, however, that centers were established for the specialized treatment of casualties with paralysis of the facial nerve. In April 1945, through the efforts of Col. Norton Canfield, MC, senior consultant in otolaryngology, European Theater of

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[1] The Medical Department of the United States Army in the World War. Washington: Government Printing Office, 1927, vol. XI, pt. 1, p. 1068.

[2] Ney, K. W.: Facial Paralysis and the Surgical Repair of the Facial Nerve. Laryngoscope 32: 327–347, May 1922.

[3] Bunnell, S.: Surgical Repair of the Facial Nerve. Arch. Otolaryng. 25: 235–359, March 1937.

[4] Ballance, C., and Duell, A. B.: Operative Treatment of Facial Palsy by Introduction of Nerve Grafts Into Fallopian Canal and by Other Intratemporal Methods. Arch. Otolaryng. 15: 1–70, January 1932.

Operations, and Col. R. Glen Spurling, MC, senior consultant in neurosurgery in the same theater, three hospitals (the 192d, the 157th, and the 52d General Hospitals) in the European Theater of Operations were designated as specialized centers for the treatment of facial-nerve paralysis. In December 1945, through the efforts of the same officers, a center for the same purpose, under the direction of Lt. Col. Frank D. Lathrop, MC, was established at Cushing General Hospital, Framingham, Mass.[5]

Before the establishment of facial-nerve centers, there was no uniform policy for the treatment of paralysis of the facial nerve. The type of treatment rendered depended upon the ability of the professional personnel of the installation in which the patient was hospitalized. Since the majority of facial paralyses were regarded as within the neurosurgical field, treatment, if any at all was instituted, consisted of (1) an anastomotic operation between the distal end of the facial nerve and the proximal end of an adjacent motor nerve, or (2) correction of the facial deformity by means of fascia lata implants. It was only in the occasional hospital that the more recent advances in surgery of the facial nerve, namely, end-to-end suture and nerve grafting, were utilized. The opposition of the majority of neurosurgeons to primary suture and nerve grafting in injuries of the facial nerve probably stemmed from the almost universal failures which followed grafting of defects in large peripheral nerves, as well as from the ease with which the facial nerve can be joined to the spinal accessory or hypoglossal nerve with resulting neurotization of paralyzed facial muscles.

While facial palsy may be of little military import, the individual soldier afflicted with a complete peripheral facial paralysis is likely to consider his disability as disastrous. Frequently, the constant facial deformity and hideous distortion which occur on emotional response cause him to withdraw from social contacts. Alterations in the sociologic, psychologic, and economic status of such patients are not uncommon and justify every effort being made to rehabilitate the casualty with the least possible delay.

Facial paralysis, per se, may be as effective in removing a soldier from combat duty as wounds which entail loss of tissue and which jeopardize his life. The epiphora associated with facial paralysis in which the orbicularis oculi muscle is involved prohibits the efficient aiming of small arms. Furthermore, when the paralysis is complete, the ludicrous expression of the face in emotion and the difficulty in enunciation may seriously impair the command and leadership ability of an officer or noncommissioned officer.

INCIDENCE

The delay in establishing specialized centers for the treatment of facial-nerve paralysis in World War II can probably be attributed, at least in part,

[5] Letter, Deputy Surgeon General to commanding officer, Cushing General Hospital, Framingham, Mass., 6 Dec. 1945, subject: Cushing General Hospital Designated as Center for the Establishment of Army Policy for the Treatment of Facial Nerve Paralysis.

to the relatively low incidence of this injury in previous wars. The figures are not, however, entirely consistent. According to Foerster,[6] the facial (seventh cranial) nerve was injured 120 times in 3,907 nerve injuries, including 423 cranial-nerve injuries, incurred by German troops in World War I. Statistics of the Medical Department of the United States Army [7] reveal only 72 instances of paralysis of the facial nerve in 153,537 battle casualties who survived the initial effects of their wounds in 1917 and 1918, the period of United States participation in that war.

It is quite possible that these figures do not accurately represent the frequency of facial-nerve paralysis in military personnel, because of failure to record an existing palsy in wounds associated with considerable tissue destruction and of greater immediate importance. This supposition is strengthened by an investigation of the statistics of the only other war engaged in by the United States in which the casualty figures were at all comparable to those of World War II. The history of the War of the Rebellion [8] is liberally sprinkled with abstracts of cases in which facial paralyses are described or in which the description of the wounds makes it obvious that such injuries must have occurred even though they were not recorded.

A survey of all Army hospitals in the Zone of Interior in November 1945 indicated that, at that time, about 384 patients with facial-nerve paralysis were still hospitalized. Approximately 150 injuries of this kind had been seen by a single observer (F. D. L.) in the European Theater of Operations between July 1944 and July 1945, and an additional 86 cases were subsequently observed in the Zone of Interior. The great majority of these paralyses were battle incurred. The facial nerve was explored in 84 cases to determine the nature of the nerve injury and, when possible, to effect a repair. The lesions presented emphasize the complexity of the destructive processes which can be wrought by high- and low-velocity missiles with respect to the facial nerve and also demonstrate that anatomic restoration of the continuity of the nerve is possible in the majority of cases.

ETIOLOGY AND PATHOLOGIC PROCESS

From a military point of view, facial paralysis might be idiopathic or might result from the blast of nearby explosions; fractures of the skull; penetrating or perforating wounds of the skull, paranasal sinuses, or soft tissues of the face and neck; wounds involving the mastoid process; knife or bayonet cuts of the face or neck; and ill-planned surgical incisions for repair of wounds which did not originally involve the facial nerve. Facial paralysis occurred frequently

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[6] Foerster, cited by Stookey, B., and Scarff, J.: Injuries of Peripheral Nerves, in Neurosurgery and Thoracic Surgery. *In* Military Surgical Manuals, National Research Council. Philadelphia and London: W. B. Saunders Co., 1943.

[7] The Medical Department of the United States Army in the World War. Washington: Government Printing Office, 1927, vol. XI, pt. 1, p. 81.

[8] Medical and Surgical History of the War of the Rebellion (1861-65). Washington: Government Printing Office, Surgical History, vol. II, pt. I, 1870; vol. II, pt. III, 1883.

enough following operation upon the mastoid process for suppurative disease of of the temporal bone to disturb the impression that all otolaryngologists were thoroughly conversant with the relationship of the facial nerve to the middle ear and mastoid process.

Traumatic facial paralysis in military personnel seldom occurred without associated injury of adjacent anatomic structures other than the ear and temporal bone. Most often, the wound producing the palsy involved the jaws, sinuses, eyes, or cranium. Fractures of the facial bones, mastoid process, or skull were almost always present, and concurrent paralyses of the second, fifth, sixth, eighth, ninth, tenth, eleventh, and twelfth cranial nerves were not uncommon.

Trauma to the facial nerve as a result of battle wounds varied with the etiology and the location and extent of the wound. The extent of the wound was of significance in estimating the injury sustained by the nerve. Extensive wounds frequently presented more than one area of damage to the facial nerve, a matter which could be determined only by careful exploration of the nerve in the path of the wound. For example, the facial nerve in one case in this series was found at operation to present a large neuroma at the level of the stylomastoid foramen, partial destruction of the cervical trunk, and avulsion of the pes anserinus and adjacent branches. In another case, the injury consisted of a large defect in the vertical course of the nerve in the fallopian canal and section of the superior branches in the face. Gutter wounds of the temporal bone superior to the external auditory canal and wounds which grazed the mastoid process produced a concussional type of palsy, which was usually followed by spontaneous recovery.

Wounds involving the mastoid process at or below the level of the external auditory canal produced facial paralysis as a result of contusion or destruction of a portion of the nerve. Penetrating or perforating wounds with the point of entrance or exit situated just anterior to the lobule of the ear frequently severely injured the pes anserinus (fig. 30). Branches of the facial nerve in its facial distribution were occasionally contused or severed by a deep laceration, with resulting partial paralysis of the face.

Knowledge of the nature of the agent producing the paralysis was important in the appraisal of the nerve injury but could not always be obtained. On the other hand, even though the patient frequently was unable to describe the circumstances of wounding, sufficient data could usually be collected to permit an evaluation of the effect of blast and of high- and low-velocity missiles upon the facial nerve.

Facial paralysis secondary to the blast of nearby explosions apparently was the result of an intraneural pathologic change produced by the pressure waves associated with such explosions. In none of these cases was a fracture of the temporal bone discernible on roentgenologic examination, and spontaneous recovery occurred in every instance. Deafness and rupture of the tympanic membrane, as further evidence of the blast effect, were present in every case.

High- and low-velocity missiles, on the other hand, produced facial palsy as a result of concussion, compression, contusion, or interruption of the nerve, and these lesions were almost always associated with fractures of the temporal, mandibular, or maxillary bones. Little difference was noted in the degree of destruction of the facial nerve caused by either of these types of projectiles. High-velocity missiles produced either (1) wounds of the perforating type, with small entrance and exit points and extensive fracturing of the mastoid process, or (2) large gutter wounds of the soft tissue, with relatively slight damage to the mastoid. The flat trajectory which characterizes these missiles caused



FIGURE 30.—Type of wound which frequently results in destruction of pes anserinus, thus prohibiting reestablishment of neuromuscular complex.

roughly horizontally lying wounds which tended to involve the facial nerve, in the region of the stylomastoid foramen or the cervical trunk or in its facial distribution.

Injury to the facial nerve by low-velocity missiles was almost always associated with extensive fracturing or destruction of the mastoid process and immediately adjacent structures. These wounds, which were of the penetrating type, produced wide destruction of the facial nerve. It was in these injuries that concurrent paralyses of the cranial nerves traversing the pharyngomaxillary space were most frequently seen. On occasion, minute fragments might enter the external auditory canal or pass between the stylomastoid foramen and the mastoid tip either to contuse or to section the facial nerve.

Knife and bayonet wounds of the face causing facial paralysis were infrequent in the cases in this series. When facial paralyses secondary to such wounds were encountered, it was relatively simple to effect repair by primary suture because of (1) the lack of displacement or of wide destruction of the nerve and (2) the ease with which mobilization of the severed branches could be accomplished. A striking feature of such wounds was the frequent failure to locate and approximate the cut ends of the nerve at the time the original closure of the injury was performed.

Facial paralysis secondary to fractures of the base of the skull did not occur as frequently as might have been anticipated with the high degree of mechanization of modern warfare. The palsy in such cases resulted from compression, contusion, or interruption of the facial nerve in its intratympanic or petrosal course. From a therapeutic point of view, the most annoying feature of palsies of this origin was the extreme difficulty in effecting decompression or primary suture of the facial nerve when the injury was located between the geniculate ganglion and the internal auditory meatus.

The most significant feature of those wounds, other than incised wounds, which resulted in interruption of the facial nerve, was the magnitude of the loss of nerve substance. Exploration, on occasion, demonstrated the facial nerve to be either missing or so badly traumatized as to require excision from the region of the geniculate ganglion to within a few millimeters of the pes anserinus, a distance of approximately 65 mm. Losses which involved a portion of both the mastoid and the cervical segment were common. Wounds which involved the pes anserinus as well as its immediate branches were infrequent but offered an extremely poor prognosis for repair of the nerve. Avulsion of the facial nerve in its petrosal course occurred in one case. Interruptions of lesser magnitude were usually located in the cervical trunk or in the distribution of the nerves in the face.

DETERMINATION OF LOCATION OF INJURY TO FACIAL NERVE

Civilian experience with the treatment of facial paralyses might cause one to assume that information concerning the approximate site of the injury to the nerve, as well as concerning its possible interruption, could be obtained from adequate roentgenologic studies, electrodiagnosis, and tests for taste and tearing. In the majority of the cases in this series, however, such examinations proved of relatively little practical value.

Taste testing was unreliable in the majority of instances, probably because of the severe concussion which the nerve had sustained. Tests for the presence or absence of lacrimation on nasal irritation were more reliable. Roentgenologic studies were difficult to evaluate because of the frequently poor quality of the film, the failure of displacement of the fragments in the presence of an existing fracture, or inability to determine which fracture was producing the

injury to the facial nerve. Faradic stimulation was of some value in evaluating paralyses secondary to concussion or in deciding whether or not to explore a large wound in the vicinity of the parotid gland. Galvanic response was elicited in all the cases tested.

Newer methods for the electrodiagnosis of nerve lesions became available toward the end of World War II. Electromyography, as well as the utilization of an apparatus developed by the United States Army which permits direct stimulation of a nerve with galvanic current, and the determination of the strength-duration curves of the nerve-muscle complex, proved to be quite reliable in evaluating the injury sustained by the facial nerve. It is not within the scope of this report to give a detailed description of these methods of electrodiagnosis, but it can be said that, in every case in which tests indicated that the facial nerve was either intact or interrupted, surgical exploration verified the electrodiagnostic prognostication.

THERAPEUTIC METHODS

General Considerations

The treatment of facial paralyses caused by combat-incurred injuries of the facial nerve at any point in its pathway through the temporal bone, neck, or face is surgical. The necessary surgery requires a precise knowledge of the anatomy of the facial nerve within the temporal bone, as well as of the pathologic processes within the middle or inner ear with which such injuries are frequently associated. No otologist without special training should undertake this kind of surgery.

Military facial-nerve surgery is not, however, solely an otologic problem. It is in the best interests of casualties with these injuries that they receive the combined consideration and attention of otologists and neurosurgeons and that the training and experience of both groups of specialists be pooled for the solution of what is admittedly a very difficult problem.

The grotesque facial expressions resulting from complete facial paralysis have stimulated many constructive efforts for the relief or cure of such paralyses. The monumental work of Ballance and Duell,[9] supplemented by the contributions of Bunnell,[10] Coleman,[11] Sullivan,[12] and Tickle,[13] ushered in a new era in the surgical management of facial paralysis. As a result, there were available during World War II several appropriate operations which gave satisfactory results when they were selected with due regard to the etiology of the palsy.

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[9] See footnote 4, p. 525.

[10] See footnote 3, p. 525.

[11] Coleman, C. C.: Surgical Lesions of the Facial Nerve, With Comments on its Anatomy. Ann. Surg. 119: 641-655, May 1944.

[12] Sullivan, J. A.: A Modification of the Ballance-Duell Technique in the Treatment of Facial Paralysis. Tr. Am. Acad. Ophth. 41: 232 299, 1936.

[13] Tickle, T. G.: Surgery of Facial Nerve in 300 Operated Cases. Laryngoscope 55: 191-195, May 1945.

The ultimate goal of the treatment of facial paralysis is the restoration of the physiologic function of the facial nerve insofar as the etiology and the pathologic process will permit. The method of treatment commonly described as masterful inactivity is mentioned only to be condemned. The proposal of this form of therapy, if therapy it can be called, when the trauma to the facial nerve is known to be situated distal to the geniculate ganglion, is a tacit acknowledgment of lack of information concerning nerve regeneration and of inability to cope surgically with these lesions. Spontaneous recovery from facial palsy does occur occasionally when no therapy is instituted, but the results seldom compare favorably with those obtained by surgical repair. Furthermore, in the event that spontaneous recovery does not occur, the degree of functional recovery obtained when the proper surgical procedures are finally instituted is not as satisfactory as when repair is accomplished at an earlier date.

Methods of Surgical Repair of the Facial Nerve

Operations such as decompression, end-to-end suture, nerve grafting, and anastomosis of the distal end of the facial nerve with the proximal end of an adjacent motor nerve restored the physiologic function of the facial nerve to a variable degree in the majority of cases.

In this series, decompression was readily achieved following either simple or radical mastoidectomy, whichever was indicated by the pathologic process present. Exposure of the facial nerve within the fallopian canal (fig. 31) was accomplished by removing the posterolateral wall of the fallopian canal with fine curets and flat chisels on each side of the lesions until normal nerve tissue was observed. When the facial nerve was found to be swollen following its exposure, it was necessary to slit the nerve sheath also in order to obtain adequate decompression of the nerve. To facilitate its exposure, the facial nerve could be picked up either as it emerged from the stylomastoid foramen or within the mastoid cavity at the point at which the digastric ridge meets the skeletonized posterior wall of the external auditory canal (fig. 32). On occasion, compression by displaced fragments of bone, foreign bodies, or edema could be relieved in this manner.

When the continuity of the facial nerve had been disrupted, it was necessary to reestablish a pathway for the conduction of nerve impulses from the cerebrum to the paralyzed muscles. This could be accomplished by an anastomotic operation, by primary suture, or by nerve grafting. It was desirable, whenever possible, to effect the restoration of the anatomic continuity of the facial nerve. When this was done, the final result more nearly approximated the preparalytic voluntary and emotional control of the facial musculature. When there had been little loss of substance after the divided ends had been freshened, the junction could be obtained by mobilizing the distal segment in the neck and parotid gland and by exerting traction posteriorly to gain about 6 mm. When the pathologic process permitted a radical mastoidectomy, greater losses could

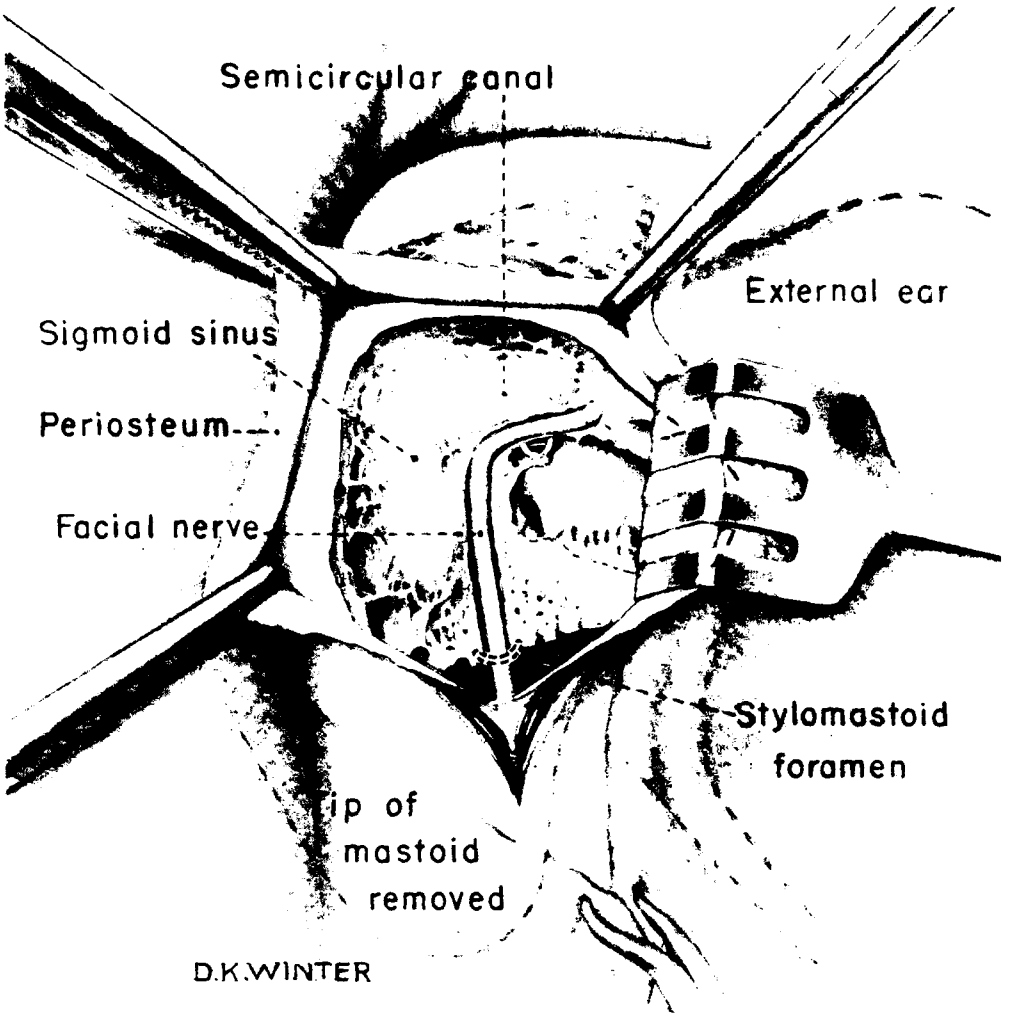


FIGURE 31. Facial nerve decompressed in its intratympanic and mastoid course following radical mastoidectomy.

be overcome by rerouting the nerve. Gaps up to 23 mm. could be closed in this way.

Rerouting the facial nerve was a simple surgical procedure (fig. 33). A radical mastoidectomy was performed, and the nerve was uncovered sufficiently to permit lifting it out of the fallopian canal from the geniculate ganglion to the stylomastoid foramen. The cervical trunk of the facial nerve was liberated from the surrounding soft tissues, and, if necessary, the dissection was carried forward into the cheek, so as to obtain greater mobilization of this portion of the nerve. Removal of the bony floor of the external auditory canal allowed the nerve to be redirected so that it coursed from the geniculate ganglion vertically across the middle ear into the neck and end-to-end suture could be accomplished without tension (fig. 34).



FIGURE 32. Exposure of facial nerve in fallopian canal at junction of digastric ridge and posterior wall of external auditory canal, without performance of mastoidectomy.

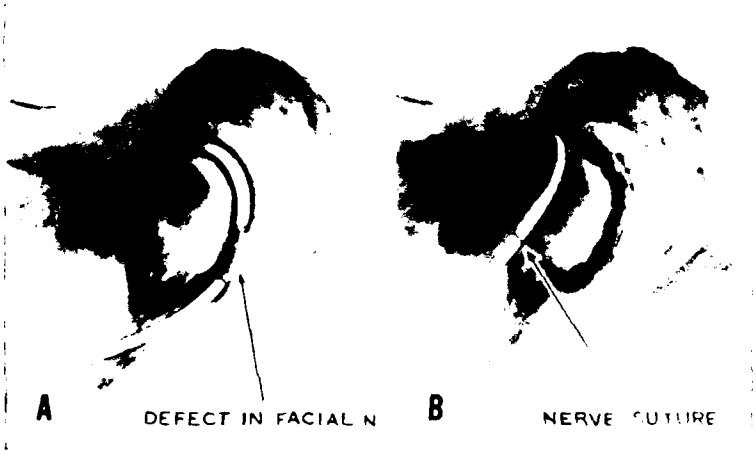


FIGURE 33. Rerouting of facial nerve. A. Facial nerve uncovered in facial canal. B. End-to-end suture accomplished.

If primary suture of the divided ends could not be accomplished by either of these procedures, recourse was had to nerve grafting to bridge the defect. For this purpose, it was convenient to utilize the anterior femoral cutaneous, the sural or the intercostal nerve, or the postauricular nerve of the cervical plexus as the donor. The anterior femoral cutaneous nerve was

used exclusively in the earlier cases comprising this series, while the postauricular nerve of the cervical plexus was utilized in the patients operated on at the facial-nerve center at Cushing General Hospital. The diameter of this nerve more closely approximates that of the facial nerve and has a firmer consistency, so that a more suitable junction is accomplished between the graft and the facial nerve. In addition, the postauricular nerve is readily accessible as it passes over the lateral aspect of the sternocleidomastoid muscle, and its exposure does not require further draping.

The technique was as follows:

The proximal and distal stumps of the facial nerve were carefully shaved until essentially normal funiculi were apparent, and measures were taken to insure a bloodless operative field. A segment of the proper length obtained from the donor nerve was inserted into the defect in the facial nerve so as to allow coaptation of the ends of the graft with those of the facial nerve (figs. 35 and 36). A nerve graft lying within the fallopian canal usually did not require suturing. In cases in which the opposing ends lay in soft tissue, it was necessary to maintain the neural junction by means of sutures or nerve glue.

A single through-and-through stitch of fine tantalum wire rather than several perineural sutures was used in this series whenever it was thought necessary to maintain the neural junction. Better apposition of the nerve ends was obtained in this way, and trauma incident to the passing of several sutures through the perineurium was reduced to the minimum. It has been



FIGURE 34.—Primary suture accomplished by nerve rerouting; defect was approximately 17 mm.



FIGURE 35.—Autogenous nerve graft, obtained from postauricular nerve, utilized to correct defect of facial nerve in its cervical course.

demonstrated that tantalum is relatively inert in peripheral nerves and that this method of nerve suturing is practicable. Maintenance of the neural junction with nerve glue was not utilized in any case in this series, but it would seem, from published reports of this method of maintaining the neural junction, that it would be admirably suited for those unions located within the fallopian canal or the small branches of the facial nerve in its facial distribution.

On occasion, it was impossible to obtain a direct line of repair of the interrupted facial nerve by end-to-end suture or nerve grafting, and, as a last resort in such instances, anastomosis of the distal stump of the facial nerve with the central end of an adjacent motor nerve was necessary to obtain neurotization of the paralyzed muscles. The spinal accessory or hypoglossal nerves are admirably suited for this purpose. Prolongation of the postauricular incision inferiorly into the neck along the anterior border of the sternomastoid muscle permitted exposure and mobilization of the central portion of either of these nerves. The distal end of the facial nerve was freed and retracted inferiorly to effect the anastomosis, which was maintained by sutures. The descendens hypoglossi was sectioned and the proximal end was sutured to the distal stump of the donor nerve in an effort to preserve tone in the muscles supplied by the latter nerve. Whether the spinal accessory or the hypoglossal nerve should be utilized in this method of treating facial paralysis is a matter

of opinion, but, as a general rule, hypoglossofacial anastomosis is reserved for patients whose livelihood depends on manual labor, while spinofacial anastomosis is reserved for those whose occupations are of a sedentary nature.

There was still an occasional case in this series in which none of the procedures described was applicable and in which indwelling mechanical support had to be supplied to obviate the unsightly deformity of the face. Total loss of the pes anserinus and inability to locate the severed branches of the facial nerve in its facial distribution were examples. Living mechanical support could be obtained by implantation of fascia lata. The skin and immediate subcutaneous tissue over the entire affected side of the face were undermined through a hockey-stick incision over the temporalis muscle. Strips of freshly obtained fascia lata were threaded through the deeper substance of the face, by means of a suitable fascial needle, in such a manner as to form three loops of fascia, one running to the upper and one to the lower lip and the third to the angle of the mouth. It was important that the fascial loops incorporated in the lips extend past the midline. The free ends of the fascial loops were adjusted and anchored within the temporalis muscle and fascia so as to cause overcorrection of the facial deformity. Excess skin was excised, the incision was closed, and a pressure dressing was applied to the face. An excellent



FIGURE 36.—Suture line obtained between distal stump of facial nerve and 60-mm. autogenous nerve graft taken from anterior femoral cutaneous nerve after graft had been sutured to proximal stump of facial nerve approximately 3 months earlier.

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cosmetic result when the face was in repose could be obtained with this method, and slight animation of the paralyzed face occurred when the temporalis muscle contracted (fig. 37).

The methods of treatment described were employed as indicated by the pathologic processes and the condition of the patient. In the majority of cases, it was necessary to explore the facial nerve from the geniculate ganglion to the principal branches of the facial distribution because of inability to determine preoperatively whether or not multiple areas of damage to the facial nerve were present. When more than one area of trauma was present,



FIGURE 37.—Left complete facial paralysis corrected by fascia lata implantation.

such reparative procedures were employed as the injury to the nerve indicated. For example, a case presenting three areas of damage to the facial nerve required (1) a nerve graft in the vertical course of the nerve, (2) primary suture of the superior branch of the pes anserinus, and (3) neurolysis of the inferior branches to restore the anatomic continuity of the nerve.

ANALYSIS OF CASES

Overseas Material

Thirty-eight of the forty-five patients operated on in the European Theater of Operations for injury to the facial nerve were variously submitted to decompression of the facial nerve, suture of the facial nerve, nerve grafting, and anastomosis of the facial to the hypoglossal nerve. In seven cases, reparative surgery on the facial nerve was not possible.

Decompression of the facial nerve was employed in 10 cases, with 8 known successful results (figs. 38, 39, and 40). One of the two remaining patients in this group died of meningitis before sufficient time had elapsed to permit return of function, and no information is available concerning the other. In all of these patients, the injury to the nerve had occurred in the fallopian canal, the neck, or the face. The degree of voluntary and emotional recovery obtained



FIGURE 38.—Return of function of right facial nerve after decompression in its mastoid, cervical, and facial course.

in several cases suggests that, when the facial nerve is severely traumatized, it would be better, even if it is grossly intact, to excise the damaged area and effect a repair by primary suture or nerve graft.

Suture of the facial nerve, by end-to-end suture of the nerve or of its branches, was employed in 12 cases, with 11 known successful results. It has not been possible to obtain a progress report from the twelfth patient. The defects in these cases ranged from 5 to 23 mm. They were overcome in six cases by adequate mobilization of the nerve, so that primary suture was possible,



FIGURE 39.—Return of function of right facial nerve after decompression in mastoid and cervical course. A. Before operation. B. After recovery following operation.

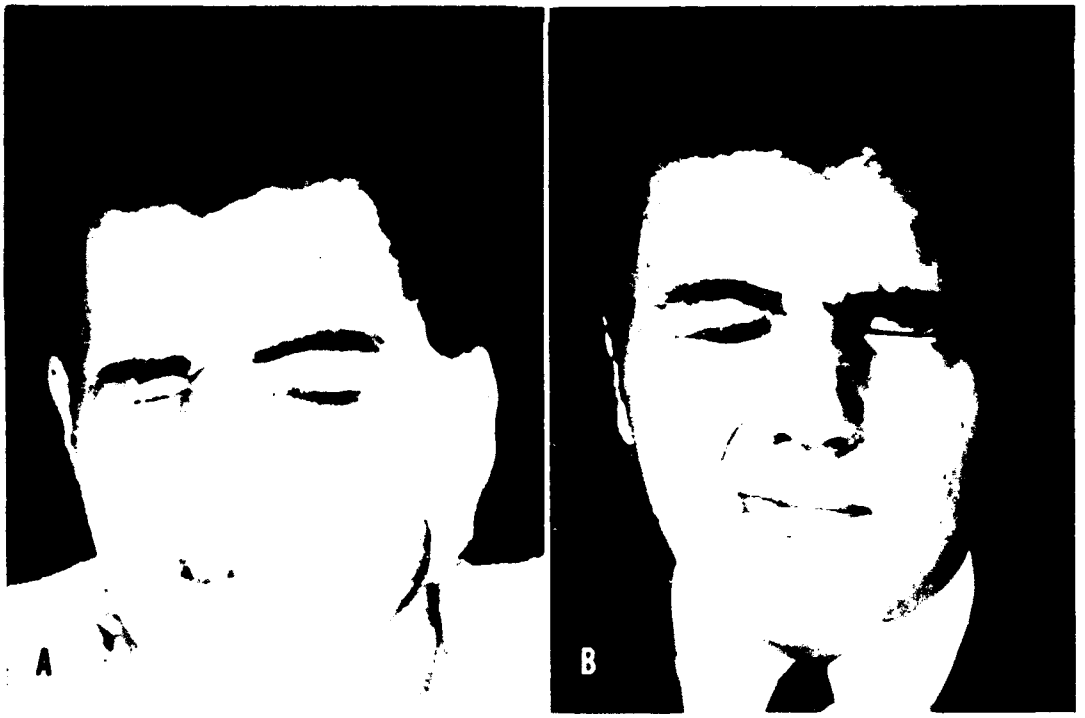


FIGURE 40.—Return of function of left facial nerve after decompression in mastoid and cervical course. A. Before operation. B. After recovery following operation.



FIGURE 41. Return of function of right facial nerve following end-to-end suture of zygomaticotemporal branch. A. Before operation. B. After recovery following operation.

without undue tension on the nerve trunk. In the other six cases, mobilization of one or more of the branches of the nerve in its facial distribution permitted satisfactory suture. In general, the voluntary and emotional play of the facial musculature in these patients has been quite satisfactory following return of function (figs. 41, 42, and 43). In those patients, however, who required decompression as well as primary suture to effect a repair, or in whom it was impossible to locate and suture all of the branches of the facial nerve, the results were not as satisfactory.

Nerve grafting was accomplished in 15 cases. Because of the skepticism prevalent among neurosurgeons concerning this method of repair of nerve injuries, particular attention was directed to the followup in these cases. From reports received from qualified neurosurgeons, it is evident that voluntary and emotional expression has been restored to the paralyzed face in 7 of the 15 patients in whom the anatomic continuity of the facial nerve was accomplished by nerve grafting. The eight other patients in this group were either examined by the operating surgeon or reported to him in writing. Six of the eight have had a return of voluntary and emotional control of the facial musculature. In general, the degree of functional restoration obtained by nerve grafting, although it varies widely, has been quite satisfactory (figs. 44 and 45). The impression exists, however, that the degree of return of facial movements obtained when the repair was effected by primary suture was superior, as a rule, to that recovered by means of nerve grafting. It would seem, therefore, that although nerve grafting is a feasible and satisfactory method of repairing defects of the facial nerve in the event that primary suture cannot be ac-



FIGURE 42. - Return of function of left facial nerve following end-to-end suture of all but mandibular branch. A. Before operation. B. After recovery following operation.



FIGURE 43. Return of function of right facial nerve following end-to-end suture of cervical trunk. A. Before operation. B. After recovery following operation.

complished, every effort should be made to overcome the defect by end-to-end suture.

In the single instance in this series in which this method was employed, the facial nerve was anastomosed with the hypoglossal nerve. The return of voluntary movements to the paralyzed side of the face was satisfactory, but the emotional response was poor. As previously stated, it is considered that



FIGURE 44.—Return of function of left facial nerve following 18-mm. autogenous nerve graft, obtained from anterior femoral cutaneous nerve.

this procedure should be reserved, as a last resort, for cases in which it is impossible to effect a repair either by primary suture or by nerve grafting.

In 7 of the 45 patients operated on for paralysis of the facial nerve, it was impossible to obtain a pathway for neurotization of the facial musculature. In this group were two patients in whom the pes anserinus and its immediate branches were so seriously damaged that repair of the facial nerve could not be effected. In one of these cases, the facial deformity was satisfactorily corrected by fascial slings. In another of these seven cases, a psychosis developed, and the patient was returned to the Zone of Interior before nerve grafting could be



FIGURE 15.—Result of suture of severed facial nerve following 55 operations in twelve years, extending from periauricular region to angle of mandible and from angle to lateral canthus of eye. A. Before operation. B. After recovery following operation.

completed. In the remaining four patients, the severed ends of one of the branches of the facial nerve could not be located in its facial distribution during the course of an operation primarily intended for excision of a scar of the face.

Zone of Interior Material

Eighty-six patients presenting peripheral facial paralyses were examined at the facial-nerve center, Cushing General Hospital, Framingham, Mass. The palsy in 56 of these cases was secondary to battle wounds. In the remaining 30 cases, paralysis occurred as a result of nonbattle injuries. Of the 56 battle injuries, 22 were the result of bullet wounds, and 34 were secondary to wounds caused by shell fragments. The lesions of the 30 patients who had facial paralyses as the result of nonbattle injuries included 7 instances of typical Bell's palsy, 8 injuries secondary to lacerations of the face, 6 secondary to skull fracture, and 4 secondary to mastoidectomy. Two injuries were incurred during operations on the face, and three were the result, respectively, of a blow on the ear, a knife wound, and a motor explosion.

Of the 86 patients with facial-nerve paralysis observed at the facial-nerve center at Cushing General Hospital, 46 had been submitted to 56 operations before their transfer to the center as follows:

In three cases, the facial nerve had been decompressed. One patient in this group had recovered from the facial palsy after operation overseas, but

paralysis had recurred after removal of a splinter of bone from the mastoid cavity at a general hospital in the Zone of Interior. When exploration of the nerve at that installation had been ineffective, the patient was transferred to the Cushing facial-nerve center, where a nerve graft was necessary to repair the defect.

In two cases, the defect in the facial nerve had been closed by primary suture. Recovery had not occurred at the time of the examination in one of these cases, but in the other (fig. 46) there was complete return of motor function to all branches of the facial nerve.

In six cases, anatomic continuity of the facial nerve had been reestablished by nerve grafting, with return of facial function in four. In one patient,

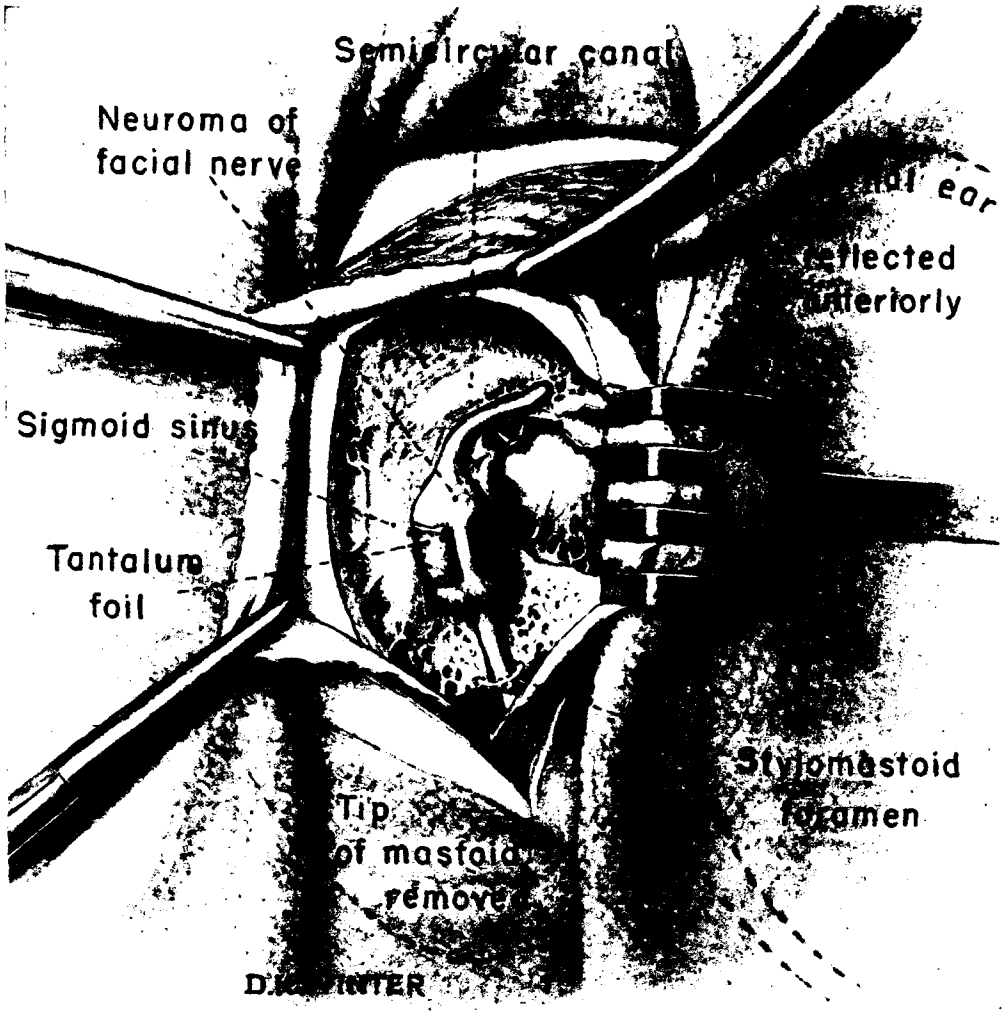


FIGURE 46.—Neuroma at site of end-to-end suture of facial nerve accomplished approximately 18 months previously. This patient obtained complete return of motor function to all branches of the facial nerve.

although there had been no return of facial movements, the facial tone was excellent, and the face in repose was symmetrical.

In eight cases, anastomotic operations had been performed. The spinal accessory and the hypoglossal nerve had been used in two cases each, with recovery from the paralysis in one case in each category. In one case, the facial nerve had been anastomosed with the great auricular nerve. In the three remaining cases, the nerve utilized to effect the anastomosis was unknown.

In the remaining cases, the facial nerve had been explored in 20, fascial slings had been used to ameliorate the facial paralysis in 10, mastoidectomy had been performed in 4, and debridement and closure of the wound had been accomplished in 3.

Of the 86 patients transferred to the facial-nerve center at the Cushing General Hospital, 39 were operated on to establish the nature of the injury to the facial nerve, to effect a repair when possible, or to study the reparative process of a facial nerve which had been repaired at an earlier date and in which there had been a return of function, as follows:

Operation	*Number of cases*
Decompression	9
Primary suture	7
Nerve grafting	[1] 17
Exploration	3
Revision of a mastoidectomy	1
Insertion of fascia lata slings	2

[1] The length of the grafts used in these patients ranged from 20 to 62 mm. The measurements in the individual cases were, respectively, 20, 21, 23, 24 (2 cases), 30, 33 (2 cases), 34 (2 cases), 35, 37 (2 cases), 31, 50, 55, and 62 mm.

Ten patients who had been operated on unsuccessfully before their transfer to the facial-nerve center were subjected to further operation at the center. The defect in the nerve was closed by means of a graft in 6 cases and in 1 by primary sutures. Decompression of the nerve was sufficient in three instances. Nine patients who had been operated on elsewhere unsuccessfully eventually revealed evidence of spontaneous recovery from the paralysis and therefore required no further surgery.

ADDITIONAL TREATMENT

The adequate treatment of facial paralysis should incorporate not only the specific repair of the lesion of the facial nerve but also therapy directed toward the musculature in an effort to prevent undue sagging and permanent stretching of the soft tissues of the paralyzed side of the face. This is particularly true if it is expected that the paralysis will exist for a considerable period of time. Permanent sagging of the soft tissues and atrophy of the muscles will be reduced to a minimum if mechanical support, daily message, and electrical stimulation are instituted early. In this series, the paralyzed muscles of the face were supported by adhesive traction or by fascia lata slings. It would seem that the latter method of support would be more desirable, not only because it provides

more natural support to the paralyzed face but also because permanent correction of the facial asymmetry is obtained in the event that functional restoration of the facial nerve fails to occur. Experience with this method in a number of cases in this series, however, seemed to indicate that its employment may jeopardize the attainment of the maximum degree of functional recovery of the facial nerve through severance of the smaller branches of the nerve in the face. The danger of injury or infection of the cornea may be minimized and epiphora may be benefited by lateral tarsorrhaphy.

ASSESSMENT OF RESULTS

All surgical procedures described for the treatment of peripheral facial paralysis proved to be of value in this series in mitigating the palsy presented by the battle casualty. It should not be expected, however, that the physiologic function of the facial nerve can be restored to normal by the employment of any method of treating facial paralysis. Decompression, end-to-end suture, and nerve grafting of the facial nerve restored the physiologic function of the nerve to a variable degree in the majority of instances and permitted the greatest possible return of emotional response to the paralyzed face. This latter aspect of the palsy was of greatest concern to the patient, and it was only by reestablishing the original neurogenic pathway from the cerebral cortex to the facial muscles that the maximum emotional recovery could be attained. Although spinofacial or hypoglossofacial anastomosis frequently resulted in better voluntary movement of the facial musculature than did the other procedures mentioned, the emotional response was usually inferior. In addition, such anastomoses commonly produced associated movements of the face on swallowing or moving the shoulders which were annoying to the patient. The degree of symmetrical response of the face to emotional stimulation after any of these operations was influenced by the patient's ability to depress the play of emotion on the normal side of the face while overaccentuating the opposite facial movements. This could best be accomplished when the normal pathway for the transmission of such impulses from the cerebral cortex had been restored.

RECOMMENDATIONS

Final evaluation of the results obtained in those cases in this series in which the injury to the facial nerve was repaired at the facial-nerve center, Cushing General Hospital, is not yet possible. As of July 1947, progress reports have been received from only two patients; both were subjected to nerve grafting, and both have had a return of facial-nerve function.[14] It is not to be expected, however, that the results likely to be obtained will compare favorably with the

[14] Since preparation of this section, Dr. Lathrop has attempted to obtain progress reports from other patients who had been subjected to nerve grafting. Unfortunately, the number of replies received have been insufficient to make any additional estimation as to the degree of recovery.—J. B. C., Jr.

results obtained in those patients operated on in the European Theater of Operations, as in many instances the palsy had existed for longer than a year when operation was undertaken. Clinical experience seems to indicate that the degree of recovery obtained by restoration of the anatomic continuity of the facial nerve after a facial palsy has existed for longer than 6 months is not as satisfactory as that obtained when repair is carried out at an earlier date.

The degree of recovery of the function of the facial nerve obtained in the series of patients operated on in the European Theater of Operations when decompression, primary suture, and nerve grafting of the facial nerve were accomplished demonstrates the feasibility of these methods of treating peripheral facial palsy of traumatic origin when the lesion of the nerve is distal to the geniculate ganglion. It is logical to assume that the maximum return of function that can occur in a paralyzed motor-nerve-muscle complex can be obtained only by restoration of the original status of the complex insofar as possible. This assumption has been verified by animal experimentation and is attested to by those surgeons who have had experience with spinofacial or hypoglossofacial anastomoses, as well as with decompression, primary suture, or nerve grafting of the facial nerve to effect restoration of voluntary and emotional response to a paralyzed face. It would seem advisable, therefore, to establish facial-nerve centers early, in the event of another war, in order that casualties presenting facial-nerve paralyses might promptly receive the benefit of those methods of treatment that best suit the individual case. It would also seem advisable to institute a program now which could be carried on by the facial-nerve centers, in the event the necessity arose for their formation, through which those patients exhibiting a paralysis of the facial nerve could be assured that the method of treatment instituted was one that offered the greatest opportunity of obtaining the maximum amount of recovery possible at a time when the greatest benefit could be expected.

The facial nerve should be explored in every patient presenting a facial paralysis as a result of a wound of the face, neck, or temporal bone in whom a negative faradic response on electrical testing of the facial muscles has been obtained. This policy would allow exact evaluation of the trauma sustained by the facial nerve, would permit the institution of the form of treatment best suited to the special case, and would prevent a palsy from continuing for a period of time detrimental to the degree of recovery that might be expected from the institution of the correct treatment.

APPENDIX A

Diseases and Injuries of the Eye

The following tables prepared by the Medical Statistics Division, Office of the Surgeon General, present statistical data on diseases and injuries of the eye in the United States Army during World War II:

TABLE 1.—*Number of admissions to hospitals and quarters for diseases of the eye in the United States Army (worldwide): By diagnosis and year, 1942–45 (exclusive of outpatients)*

[Preliminary data based on sample tabulations of individual medical records]

Diagnosis	1942–45	1942	1943	1944	1945
	Number	*Number*	*Number*	*Number*	*Number*
Diseases of the eye, total	210, 534	25, 624	69, 616	64, 439	50, 855
Refractive errors, total	28, 809	2, 484	13, 625	6, 635	6, 065
Diseases of the conjunctiva, total	57, 992	8, 578	17, 970	16, 539	14, 905
Catarrhal conjunctivitis	(35, 251)	(6, 169)	(12, 589)	(9, 688)	(6, 805)
Granular conjunctivitis (trachoma)	(826)	(164)	(351)	(171)	(140)
Other and unspecified	(21, 915)	(2, 245)	(5, 030)	(6, 680)	(7, 960)
Iritis, total	8, 382	954	2, 268	2, 775	2, 385
Diseases of the cornea, total	18, 357	2, 213	5, 550	5, 624	4, 970
Corneal ulcer	(8, 777)	(1, 246)	(2, 495)	(2, 641)	(2, 395)
Keratitis	(7, 606)	(789)	(2, 223)	(2, 544)	(2, 050)
Corneal opacity	(1, 772)	(162)	(772)	(383)	(455)
Conical cornea	(202)	(16)	(60)	(56)	(70)
Diseases of the retina, total	3, 832	670	1, 462	945	755
Detachment of retina	(956)	(93)	(314)	(284)	(265)
Other and unspecified	(2, 876)	(577)	(1, 148)	(661)	(490)
Diseases of choroid, total	5, 217	493	1, 603	1, 521	1, 600
Detachment of choroid	(7)	----	(1)	(6)	----
Other and unspecified	(5, 210)	(493)	(1, 602)	(1, 515)	(1, 600)
Diseases of the eyelids	20, 744	3, 042	6, 435	6, 137	5, 130
Blepharitis	(3, 624)	(445)	(1, 061)	(1, 128)	(990)
Hordeolum	(8, 235)	(1, 354)	(2, 586)	(2, 560)	(1, 735)
Other and unspecified	(8, 885)	(1, 243)	(2, 788)	(2, 449)	(2, 405)
Other diseases of the eye, total	67, 201	7, 190	20, 703	24, 263	15, 045
Amblyopia	(6, 260)	(615)	(3, 317)	(1, 293)	(1, 035)
Cataract	(3, 523)	(399)	(1, 459)	(870)	(795)
Glaucoma	(1, 203)	(140)	(458)	(310)	(295)
Ophthalmoplegia	(818)	(122)	(353)	(168)	(175)
Strabismus	(9, 950)	(1, 454)	(4, 620)	(2, 236)	(1, 640)
Optic atrophy, not hereditary	(1, 150)	(139)	(517)	(284)	(210)
Pterygium	(12, 776)	(2, 411)	(4, 204)	(3, 526)	(2, 635)
Other and unspecified	(31, 521)	(1, 910)	(5, 775)	(15, 576)	(8, 260)

NOTE.—Figures in parentheses are subtotals.

TABLE 2.—*Number of admissions to hospitals and quarters for diseases of the eye in the United States Army (continental United States). By diagnosis and year, 1942–45 (exclusive of outpatients)*

[Preliminary data based on sample tabulations of individual medical records]

Diagnosis	1942–45	1942	1943	1944	1945
	Number	*Number*	*Number*	*Number*	*Number*
Diseases of the eye, total	126, 436	20, 864	52, 245	34, 432	18, 895
Refractive errors, total	18, 053	2, 128	11, 500	2, 575	1, 850
Diseases of the conjunctiva, total	27, 119	6, 673	11, 190	6, 001	3, 255
Catarrhal conjunctivitis	(18, 649)	(4, 813)	(7, 930)	(4, 166)	(1, 740)
Granular conjunctivitis (trachoma)	(538)	(138)	(240)	(90)	(70)
Other and unspecified	(7, 932)	(1, 722)	(3, 020)	(1, 745)	(1, 445)
Iritis, total	5, 025	771	1, 710	1, 469	1, 075
Diseases of the cornea, total	10, 452	1, 865	4, 055	2, 717	1, 815
Corneal ulcer	(4, 780)	(1, 020)	(1, 805)	(1, 200)	(755)
Keratitis	(4, 294)	(695)	(1, 575)	(1, 229)	(795)
Corneal opacity	(1, 225)	(137)	(620)	(243)	(225)
Conical cornea	(153)	(13)	(55)	(45)	(40)
Diseases of the retina, total	2, 845	603	1, 250	582	410
Detachment of retina	(709)	(78)	(275)	(191)	(165)
Other and unspecified	(2, 136)	(525)	(975)	(391)	(245)
Diseases of choroid, total	3, 255	417	1, 265	798	775
Detachment of choroid	(3)	-------	-------	(3)	-------
Other and unspecified	(3, 252)	(417)	(1, 265)	(795)	(775)
Diseases of the eyelids	9, 794	2, 266	4, 025	2, 283	1, 220
Blepharitis	(1, 453)	(309)	(615)	(349)	(180)
Hordeolum	(3, 843)	(989)	(1, 470)	(949)	(435)
Other and unspecified	(4, 498)	(968)	(1, 940)	(985)	(605)
Other diseases of the eye, total	49, 893	6, 141	17, 250	18, 007	8, 495
Amblyopia	(4, 754)	(555)	(3, 005)	(739)	(455)
Cataract	(2, 460)	(346)	(1, 270)	(519)	(325)
Glaucoma	(934)	(122)	(420)	(227)	(165)
Ophthalmoplegia	(591)	(108)	(285)	(93)	(105)
Strabismus	(7, 866)	(1, 294)	(4, 165)	(1, 467)	(940)
Optic atrophy, not hereditary	(941)	(128)	(475)	(213)	(125)
Pterygium	(7, 891)	(2, 003)	(3, 065)	(1, 743)	(1, 080)
Other and unspecified	(24, 456)	(1, 585)	(4, 565)	(13, 006)	(5, 300)

NOTE.—Figures in parentheses are subtotals.

TABLE 3.—*Number of admissions to hospitals and quarters for diseases of the eye in the United States Army (overseas): By diagnosis and year, 1942–45 (exclusive of outpatients)*

[Preliminary data based on sample tabulations of individual medical records]

Diagnosis	1942–45	1942	1943	1944	1945
	Number	*Number*	*Number*	*Number*	*Number*
Diseases of the eye, total	84, 098	4, 760	17, 371	30, 607	31, 960
Refractive errors, total	10, 756	356	2, 125	4, 060	4, 215
Diseases of the conjunctiva, total	30, 873	1, 905	6, 780	10, 538	11, 650
Catarrhal conjunctivitis	(16, 602)	(1, 356)	(4, 659)	(5, 522)	(5, 065)
Granular conjunctivitis (trachoma)	(288)	(26)	(111)	(81)	(70)
Other and unspecified	(13, 983)	(523)	(2, 010)	(4, 935)	(6, 515)
Iritis, total	3, 357	183	558	1, 306	1, 310
Diseases of the cornea, total	7, 905	348	1, 495	2, 907	3, 155
Corneal ulcer	(3, 997)	(226)	(690)	(1, 441)	(1, 640)
Keratitis	(3, 312)	(94)	(648)	(1, 315)	(1, 255)
Corneal opacity	(547)	(25)	(152)	(140)	(230)
Conical cornea	(49)	(3)	(5)	(11)	(30)
Diseases of the retina, total	987	67	212	363	345
Detachment of retina	(247)	(15)	(39)	(93)	(100)
Other and unspecified	(740)	(52)	(173)	(270)	(245)
Diseases of choroid, total	1, 962	76	338	723	825
Detachment of choroid	(4)	----	(1)	(3)	----
Other and unspecified	(1, 958)	(76)	(337)	(720)	(825)
Diseases of the eyelids	10, 950	776	2, 410	3, 854	3, 910
Blepharitis	(2, 171)	(136)	(446)	(779)	(810)
Hordeolum	(4, 392)	(365)	(1, 116)	(1, 611)	(1, 300)
Other and unspecified	(4, 387)	(275)	(848)	(1, 464)	(1, 800)
Other diseases of the eye, total	17, 308	1, 049	3, 453	6, 256	6, 550
Amblyopia	(1, 506)	(60)	(312)	(554)	(580)
Cataract	(1, 063)	(53)	(189)	(351)	(470)
Glaucoma	(269)	(18)	(38)	(83)	(130)
Ophthalmoplegia	(227)	(14)	(68)	(75)	(70)
Strabismus	(2, 084)	(160)	(455)	(769)	(700)
Optic atrophy, not hereditary	(209)	(11)	(42)	(71)	(85)
Pterygium	(4, 885)	(408)	(1, 139)	(1, 783)	(1, 555)
Other and unspecified	(7, 065)	(325)	(1, 210)	(2, 570)	(2, 960)

NOTE.—Figures in parentheses are subtotals.

TABLE 4.—*Admission rates for diseases of the eye in the United States Army (worldwide): By diagnosis and year, 1942–45 (exclusive of outpatients)*

[Preliminary data based on sample tabulations of individual medical records]

[Rate expressed as number of admissions per annum per 1,000 average strength]

Diagnosis	1942–45	1942	1943	1944	1945
	Rate	*Rate*	*Rate*	*Rate*	*Rate*
Diseases of the eye, total	8. 26	7. 90	10. 13	8. 27	6. 71
Refractive errors, total	1. 13	. 77	1. 98	. 85	. 80
Diseases of the conjunctiva, total	2. 28	2. 64	2. 62	2. 12	1. 97
Catarrhal conjunctivitis	(1. 39)	(1. 90)	(1. 84)	(1. 24)	(. 90)
Granular conjunctivitis (trachoma)	(. 03)	(. 05)	(. 05)	(. 02)	(. 02)
Other and unspecified	(. 86)	(. 69)	(. 73)	(. 86)	(1. 05)
Iritis, total	. 33	. 29	. 33	. 36	. 31
Diseases of the cornea, total	. 72	. 68	. 81	. 72	. 66
Corneal ulcer	(. 34)	(. 39)	(. 37)	(. 33)	(. 32)
Keratitis	(. 30)	(. 24)	(. 32)	(. 33)	(. 27)
Corneal opacity	(. 07)	(. 05)	(. 11)	(. 05)	(. 06)
Conical cornea	(. 01)	(0)	(. 01)	(. 01)	(. 01)
Diseases of the retina, total	. 15	. 21	. 21	. 12	. 10
Detachment of retina	(. 04)	(. 03)	(. 05)	(. 04)	(. 03)
Other and unspecified	(. 11)	(. 18)	(. 16)	(. 08)	(. 07)
Diseases of choroid, total	. 20	. 15	. 23	. 20	. 21
Detachment of choroid	(0)	------	(0)	(0)	------
Other and unspecified	(. 20)	(. 15)	(. 23)	(. 20)	(. 21)
Diseases of the eyelids, total	. 81	. 94	. 94	. 79	. 68
Blepharitis	(. 14)	(. 14)	(. 15)	(. 14)	(. 13)
Hordeolum	(. 32)	(. 42)	(. 38)	(. 34)	(. 23)
Other and unspecified	(. 35)	(. 38)	(. 41)	(. 31)	(. 32)
Other diseases of the eye, total	2. 64	2. 22	3. 01	3. 11	1. 98
Amblyopia	(. 25)	(. 19)	(. 48)	(. 17)	(. 14)
Cataract	(. 14)	(. 12)	(. 21)	(. 11)	(. 10)
Glaucoma	(. 05)	(. 04)	(. 07)	(. 04)	(. 04)
Ophthalmoplegia	(. 03)	(. 04)	(. 05)	(. 02)	(. 02)
Strabismus	(. 39)	(. 45)	(. 67)	(. 29)	(. 22)
Optic atrophy, not hereditary	(. 05)	(. 04)	(. 08)	(. 04)	(. 03)
Pterygium	(. 50)	(. 75)	(. 61)	(. 45)	(. 35)
Other and unspecified	(1. 23)	(. 59)	(. 84)	(1. 99)	(1. 08)

NOTE.—Figures in parentheses are subtotals.

TABLE 5.- *Admission rates for diseases of the eye in the United States Army (continental United States): By diagnosis and year, 1942-45 (exclusive of outpatients)*

[Preliminary data based on sample tabulations of individual medical records]

[Rate expressed as number of admissions per annum per 1,000 average strength]

Diagnosis	1942-45	1942	1943	1944	1945
	Rate	*Rate*	*Rate*	*Rate*	*Rate*
Diseases of the eye, total	8. 58	7. 85	10. 08	8. 67	6. 45
Refractive errors, total	1. 22	. 80	2. 22	. 65	. 63
Diseases of the conjunctiva, total	1. 85	2. 51	2. 16	1. 51	1. 11
Catarrhal conjunctivitis	(1. 27)	(1. 81)	(1. 53)	(1. 05)	(. 60)
Granular conjunctivitis (trachoma)	(. 04)	(. 05)	(. 05)	(. 02)	(. 02)
Other and unspecified	(. 54)	(. 65)	(. 58)	(. 44)	(. 49)
Iritis, total	. 34	. 29	. 33	. 37	. 37
Diseases of the cornea, total	. 71	. 70	. 78	. 68	. 62
Corneal ulcer	(. 33)	(. 39)	(. 35)	(. 30)	(. 26)
Keratitis	(. 29)	(. 26)	(. 30)	(. 31)	(. 27)
Corneal opacity	(. 08)	(. 05)	(. 12)	(. 06)	(. 08)
Conical cornea	(. 01)	(0)	(. 01)	(. 01)	(. 01)
Diseases of the retina, total	. 19	. 23	. 24	. 15	. 14
Detachment of retina	(. 05)	(. 03)	(. 05)	(. 05)	(. 06)
Other and unspecified	(. 14)	(. 20)	(. 19)	(. 10)	(. 08)
Diseases of choroid, total	. 22	. 16	. 24	. 20	. 26
Detachment of choroid	(0)			(0)	
Other and unspecified	(. 22)	(. 16)	(. 24)	(. 20)	(. 26)
Diseases of the eyelids	. 66	. 85	. 78	. 57	. 42
Blepharitis	(. 10)	(. 12)	(. 12)	(. 09)	(. 06)
Hordeolum	(. 26)	(. 37)	(. 28)	(. 24)	(. 15)
Other and unspecified	(. 30)	(. 36)	(. 38)	(. 24)	(. 21)
Other diseases of the eye, total	3. 39	2. 31	3. 33	4. 54	2. 90
Amblyopia	(. 32)	(. 21)	(. 58)	(. 19)	(. 16)
Cataract	(. 17)	(. 13)	(. 25)	(. 13)	(. 11)
Glaucoma	(. 06)	(. 05)	(. 08)	(. 06)	(. 06)
Ophthalmoplegia	(. 04)	(. 04)	(. 05)	(. 02)	(. 04)
Strabismus	(. 53)	(. 49)	(. 80)	(. 37)	(. 32)
Optic atrophy, not hereditary	(. 06)	(. 05)	(. 09)	(. 05)	(. 04)
Pterygium	(. 54)	(. 75)	(. 59)	(. 44)	(. 37)
Other and unspecified	(1. 67)	(. 59)	(. 89)	(3. 28)	(1. 80)

NOTE.--Figures in parentheses are subtotals.

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TABLE 6.—*Admission rates for diseases of the eye in the United States Army (overseas): By diagnosis and year, 1942–45 (exclusive of outpatients)*

[Preliminary data based on sample tabulations of individual medical records]

[Rate expressed as number of admissions per annum per 1,000 average strength]

Diagnosis	1942–45	1942	1943	1944	1945
	Rate	*Rate*	*Rate*	*Rate*	*Rate*
Diseases of the eye, total	7.83	8.13	10.29	7.86	6.88
Refractive errors, total	1.00	.61	1.27	1.06	.91
Diseases of the conjunctiva, total	2.88	3.26	4.01	2.76	2.51
Catarrhal conjunctivitis	(1.55)	(2.32)	(2.76)	(1.45)	(1.09)
Granular conjunctivitis (trachoma)	(.03)	(.04)	(.06)	(.02)	(.02)
Other and unspecified	(1.30)	(.90)	(1.19)	(1.29)	(1.40)
Iritis, total	.31	.31	.33	.34	.28
Diseases of the cornea, total	.74	.59	.89	.76	.68
Corneal ulcer	(.38)	(.38)	(.42)	(.38)	(.35)
Keratitis	(.31)	(.16)	(.38)	(.34)	(.27)
Corneal opacity	(.05)	(.04)	(.09)	(.04)	(.05)
Conical cornea	(0)	(.01)	(0)	(0)	(.01)
Diseases of the retina, total	.09	.11	.13	.10	.07
Detachment of retina	(.02)	(.03)	(.02)	(.02)	(.02)
Other and unspecified	(.07)	(.08)	(.11)	(.08)	(.05)
Diseases of choroid, total	.18	.13	.20	.19	.18
Detachment of choroid	(0)	----	(0)	(0)	----
Other and unspecified	(.18)	(.13)	(.20)	(.19)	(.18)
Diseases of the eyelids	1.02	1.32	1.42	1.01	.84
Blepharitis	(.20)	(.23)	(.26)	(.20)	(.17)
Hordeolum	(.41)	(.62)	(.66)	(.43)	(.28)
Other and unspecified	(.41)	(.47)	(.50)	(.38)	(.39)
Other diseases of the eye, total	1.61	1.80	2.04	1.64	1.41
Amblyopia	(.14)	(.10)	(.18)	(.15)	(.12)
Cataract	(.10)	(.09)	(.11)	(.09)	(.10)
Glaucoma	(.03)	(.03)	(.02)	(.02)	(.03)
Ophthalmoplegia	(.02)	(.02)	(.04)	(.02)	(.02)
Strabismus	(.19)	(.27)	(.27)	(.20)	(.15)
Optic atrophy, not hereditary	(.02)	(.02)	(.02)	(.02)	(.02)
Pterygium	(.45)	(.71)	(.67)	(.47)	(.33)
Other and unspecified	(.66)	(.56)	(.73)	(.67)	(.64)

NOTE.—Figures in parentheses are subtotals.

TABLE 7.—*Incidence of diseases of the eye in the United States Army (worldwide): By diagnosis, 1944–45*

[Preliminary data based on sample tabulations of individual medical records]

[Rate expressed as number per annum per 1,000 average strength]

Diagnosis	Total cases	Primary diagnosis	Secondary diagnosis	Total cases	Primary diagnosis
	Number	*Number*	*Number*	*Rate*	*Rate*
Diseases of the eye, total	226, 084	115, 294	110, 790	14. 71	7. 50
Refractive errors, total	47, 450	12, 700	34, 750	3. 08	. 83
Diseases of the conjunctiva, total	45, 649	31, 444	14, 205	2. 97	2. 05
Catarrhal conjunctivitis	(24, 253)	(16, 493)	(7, 760)	(1. 57)	(1. 08)
Granular conjunctivitis (trachoma)	(411)	(311)	(100)	(. 03)	(. 02)
Other and unspecified	(20, 985)	(14, 640)	(6, 345)	(1. 37)	(. 95)
Iritis, total	7, 865	5, 160	2, 705	. 51	. 34
Diseases of the cornea, total	19, 479	10, 594	8, 885	1. 27	. 69
Corneal ulcer	(8, 221)	(5, 036)	(3, 185)	(. 53)	(. 33)
Keratitis	(6, 839)	(4, 594)	(2, 245)	(. 45)	(. 30)
Corneal opacity	(4, 258)	(838)	(3, 420)	(. 28)	(. 05)
Conical cornea	(161)	(126)	(35)	(. 01)	(. 01)
Diseases of the retina, total	4, 325	1, 700	2, 625	. 28	. 11
Detachment of retina	(1, 219)	(549)	(670)	(. 08)	(. 04)
Other and unspecified	(3, 106)	(1, 151)	(1, 955)	(. 20)	(. 07)
Diseases of choroid, total	6, 121	3, 121	3, 000	. 40	. 20
Detachment of choroid	(21)	(6)	(15)	(0)	(0)
Other and unspecified	(6, 100)	(3, 115)	(2, 985)	(. 40)	(. 20)
Diseases of the eyelids	18, 797	11, 267	7, 530	1. 22	. 73
Blepharitis	(3, 953)	(2, 118)	(1, 835)	(. 26)	(. 14)
Hordeolum	(6, 125)	(4, 295)	(1, 830)	(. 40)	(. 28)
Other and unspecified	(8, 719)	(4, 854)	(3, 865)	(. 56)	(. 31)
Other diseases of the eye, total	76, 398	39, 308	37, 090	4. 98	2. 55
Amblyopia	(9, 903)	(2, 328)	(7, 575)	(. 64)	(. 15)
Cataract	(5, 775)	(1, 665)	(4, 110)	(. 38)	(. 11)
Glaucoma	(1, 405)	(605)	(800)	(. 09)	(. 04)
Ophthalmoplegia	(1, 038)	(343)	(695)	(. 07)	(. 02)
Strabismus	(8, 871)	(3, 876)	(4, 995)	(. 58)	(. 25)
Optic atrophy, not hereditary	(1, 704)	(494)	(1, 210)	(. 11)	(. 03)
Pterygium	(8, 876)	(6, 161)	(2, 715)	(. 58)	(. 40)
Other and unspecified	(38, 826)	(23, 836)	(14, 990)	(2. 53)	(1. 55)

NOTE.—Figures in parentheses are subtotals.

TABLE 8.—*Admissions for eye injuries and wounds among battle casualties in the United States Army: By causative agent, 7 December 1941 through 31 December 1943*

[Preliminary data based on tabulations of individual medical records]

Causative agent	Admissions		
	Number	Rate [1]	Percent
Battle injuries and wounds of the eye	468	0.21	100.0
Bomb and bomb fragment	20	.01	4.3
Shell, shell fragment, and flak	236	.10	50.4
Bullet, machinegun, rifle, etc	30	.01	6.4
Land mine, boobytrap	44	.02	9.4
Grenade and grenade fragment	17	.01	3.6
Explosion, ammunition, weapon, and other	12	.01	2.6
Other and unspecified	109	.05	23.3

[1] Rate expressed as number per annum per 1,000 average strength in the total oversea areas.

TABLE 9.—*Admissions for eye injuries and wounds among battle casualties in the United States Army: By causative agent and theater, 1944*

[Preliminary data based on sample tabulations of individual medical records]

[Rate expressed as number of admissions per annum per 1,000 average strength]

Causative agent	Total overseas [1]		Europe		Mediterranean		Southwest Pacific		Central and South Pacific		Other areas	
	Number	*Rate*	*Number*	*Rate*	*Number*	*Rate*	*Number*	*Rate*	*Number*	*Rate*	*Number*	*Rate*
Battle injuries and wounds of the eye	7,805	2.04	5,660	3.37	1,610	2.48	320	0.59	195	0.44	20	0.04
Bomb and bomb fragment	185	.05	130	.08	30	.05	20	.04	5	.01	------	------
Shell, shell fragment, and flak	4,675	1.21	3,425	2.04	985	1.52	160	.29	95	.21	10	.02
Bullet, machinegun, rifle, etc	605	.16	465	.27	65	.10	45	.07	25	.06	5	.01
Land mine, boobytrap	695	.18	495	.30	190	.28	10	.02	------	------	------	------
Grenade and grenade fragment	480	.13	330	.20	75	.12	30	.06	45	.10	------	------
Explosion, ammunition, weapon, and other	180	.05	100	.06	45	0.7	30	.06	5	.01	------	------
Other and unspecified	985	.26	715	.42	220	.34	25	.05	20	.05	5	.01

[1] No battle cases were directly admitted in the continental United States.

APPENDIX B

Personal Experience of a Blinded Casualty

A letter, written to the consultant in ophthalmology in the Office of the Surgeon General, relates the personal experiences of a blinded soldier who was the first patient to enter the Valley Forge General Hospital Eye Center under the Army blind program and who later returned to the institution as blind consultant. Four years after the end of the war, he was successfully operating a shop of his own. This letter is included as part of the history of the blind program because it is typical of how one man learned to adapt himself to his blindness and did it so successfully that he was able to teach others what he himself had been taught.

MAY 18, 1946.

DEAR DR. GREEAR:

* * * * * * *

As you probably remember, the Valley Forge General Hospital was opened to patients in March, 1943. Sgt. * * * and I were the very first blind patients to be admitted to the hospital; that was on Easter morning, April, 1943 * * * .

During my four months' stay at the hospital, I needed very little medication. Therefore, I spent half the time at my home in Lebanon. Sgt. * * * needed a lot of work done on his face. There was no program set up to take care of the rehabilitation of such personnel with the condition of blindness. But soon some arrangements were made and a Mrs. Post was transferred from Washington to Valley Forge to handle duties as a recreational worker for Red Cross. Although not authorized to do so, she started to give Sgt. * * * and me some training in typing and Braille. She was not a teacher, but she did a fine job in showing us some of the things we could learn to do. She gave us Braille playing cards and showed us how to play Chinese Checkers and ordinary checkers. Also, the Red Cross made arrangements for us to receive Braille watches from the American Foundation for the Blind. Later, several talking book machines were received and I know that * * * and I started to do some reading. The Red Cross tried to interest us in stage shows as well as certain types of movies that were shown in the hospital auditorium. Sgt. * * * had learned to weave mats in the Camp Carson Station Hospital in Colorado, where we were treated after the booby trap explosion in that camp. These were worked on a wooden frame on which were nails to hold the cotton warp. He made hot pads, place mats and doilies, all of different colors and design. It was a Gray Lady, a Miss Patterson of Colorado Springs, who had instructed him. At Valley Forge, he showed me how to weave, and * * * and I spent our time weaving mats, listening to the talking books, typing, and learning Braille. * * * were also early comers to Valley Forge General Hospital. A large majority of the men in Ward 16, for that is where they were located, became "mat happy." They had different size frames and made mats of all types—especially popular were the daisy mats. They took turns reading the talking books, for there were only a couple of machines there at the time. I was located in Ward 6, which even from the beginning was the officers' ward. However, I spent much time in Ward 16 with * * * and the rest of the fellows. In fact, we formed a squad, and I was the drill master, * * * was the squad leader, and * * * always brought up the rear. We drilled

around the ward and went to the PX and other places in the hospital. I remember that the Red Cross tried to do all they could to help. I know that they took several of us on a trip in the station wagon to visit Valley Forge Park one day, which represented a high point in entertainment to us then.

I was fitted with a plastic eye * * *. My medication was complete three or four weeks after my arrival. Around June it was thought that I would be sent to Hines General Hospital in Chicago for rehabilitation. It was also around June that Mortimer Frankston came from a camp in Texas on orders from the Surgeon General's Office telling him to help in the orientation of the blinded men. I remember coming back from sick leave and meeting him at which time he began my instruction. He spoke with my wife frequently, advising her to make sure I kept my shoes shined, hair combed, properly clothed, shaved, etc. He told her not to baby me or give me sympathy. Frankston worked on me with his philosophy, which he found was about the same as my own, as well as in personal matters such as shaving, dressing, polishing shoes, combing, etc. He instructed me in the proper use of a cane. I remember his stressing the idea that I must learn to walk in a straight line, the keen use of ears and memory work, the awareness of objects, asking of directions, inside travel, and later downtown travel. After a few lessons in this, he told me that there was very little more he could do for me and that it was up to me to continue my development. By this time there were about ten fellows or so and he wanted to devote more time to them. He talked to me about my future plans as had Captain Abbott.

I was discharged August 21, 1943, and at home I studied Braille with my wife with the Loomis books "You Can Learn To Read Braille," while waiting for my call to Washington to start my training. Major Barton from the Surgeon General's Office had told me that I could have the job of Blind Consultant at the Valley Forge General Hospital. At the same time I had opportunities to go into Veterans Administration or work with the civilian blind. I did not consider the latter two offers but did agree to help the buddies for a while in the other capacity, thereby laying aside for the time being my desire to train for Physical Therapy work which was what I felt I wanted to do. I took special training in Washington then and in Canada and several states. This work was planned by L. Q. Lewis of the National Society for the Blind and J. F. Clunk, then Chief, Services for the Blind, U. S. Office of Education. During my training period, I believe in the month of September, Miss Rosalie F. Cohen came to be a teacher in typing and Braille. She made herself very active and helped in giving her philosophy. She interested some of the boys in music, and plus her instruction periods acted as a rehabilitation aide, also, helping wherever she could. She made arrangements for the Braille watches for the men, which still was handled through Red Cross. On January 3, 1944, both Martha B. Miller and I came to work at the Valley Forge General Hospital. Frankston took me to meet the new eye chief, who had come to the hospital, I believe, in October, although I never did know the exact time. This was Lt. Col. James Greear, Jr. Martha was to do the same job as Miss Cohen was doing.

My job, at first, was to talk to the fellows when they first came into the hospital, answering any of their questions, giving them my philosophy, showing them around, and helping in orienting them both in the hospital and in town. I remember one day I took * * * downtown for instruction: he was to find the photograph shop which was four doors from the alley. When he entered the door he thought was the fourth from the corner, he found himself in a ladies underwear and stocking shop. In my early contacts, studying through the problem of how I could best help the fellows, and remembering the thousands of questions I had with no one around to answer them for me, I planned my task at Valley Forge. I still took care of the early contact, telling the men just why they had been sent to this particular hospital (medication). I described its lay-out and set-up, such as passes, furloughs, clothing, treatment, activities around there, and gave them an idea of Phoenixville and Philadelphia. I informed them of visiting hours, procedure in making phone calls, and many other similar little problems that confront the newly blinded person. Also, I began

to make arrangements for their Braille watches, taking their names, serial numbers, rating, and home town to Miss Cohen, who carried on from there by giving the information to Red Cross. Later on in my talks with each soldier, I made sure that he knew about insurance, pensions, training, and medication after discharge, Public Law 309, reduced travel rates on trains and buses, the seeing-eye or guide dogs, income tax reduction and the different organizations and agencies that would help the fellow after he was discharged. Most of this information I gathered from my own experience and from representatives of Veterans Administration. Realizing that the men would forget much that I told them and that many of these things would be helpful if written out for reference, I wrote all this out and had it sent to Washington where it was checked by Veterans Administration. I waited many months for its return, and in all it must have been well over a year before it was mimeographed for distribution to the men. I have enclosed a copy of this information, and of course you must remember that at the time, it was accurate. There have been changes since then. If I remember rightly, I do not believe that you ever saw a copy of it. In my early contacts, I also instructed the fellows on the use of the fiber writing board so that they could write their own letters, if they so desired, before they learned typing. And I talked to them in regard to their future, especially in connection with their employment. When the situation presented itself, I helped in orientation. At times, I discussed personal matters, when such matters arose, and if requested gave advice on marital relations, girl friends, drinking habits, handling of money, etc. And continuously I attempted to pass on my philosophy as well as to build up the morale of the blind patients.

I am sure you can carry on from here with the coming of Blackburn, Conlan, Sgt. Reed, Miss Oja, Mrs. Carter who later became Mrs. Harriet Hoover, McGovern, Bledsoe, Sgt. Riggles, orientation men, and of course Lt. Jones, Sgt. Bernbaum, Miss Simmons, Mrs. Morgan, Mrs. Mowery, Miss Bard, Miss Walker, volunteer readers, Miss Wilson, Miss Leech, Jimmy Moxom and others of the Red Cross. And you would, of course, know the eye doctors, namely, Sheehan, Merz, Moore, Taylor, and others; and the nurses, Christie, Cunningham, Vertucci, and others. As you recall, Frankston and I went out and made arrangements for the fellows to get a crack at industrial work while at Valley Forge. We started with DeSanno's Radiac plant in Phoenixville, where they made abrasive wheels and where were used five or six processes which the fellows could do successfully. Then we went to Jacob's Aircraft in Pottstown, where the plant officials and the Army Air Corps cooperated beautifully allowing us to take fellows over who spent the whole day trying out twenty or thirty different jobs which we knew they could do. Then came Rykels Laboratory, and we had many of the fellows doing work and earning good money while at the hospital. However, once Old Farms Convalescent Hospital (Sp) in Avon, Connecticut, started, we cut down on the employment until it was stopped completely, since we realized that the Old Farms would be doing that very thing as part of their training. While at Valley Forge, I personally contacted and talked with over six hundred men in nineteen months of work. That makes an average of about thirty a month or about one a day. As you probably know, I left on the last day of July and the Germans had surrendered by that time, Japan shortly afterward. I trained a Bill Hasse who worked after I left until Russ Williams, whom I had trained to take the job, returned from Avon.

Respectfully yours.

APPENDIX C

Letters to Families of Blinded Casualties

In recognition of the importance of family relationships in the case of blinded casualties, the Chief Surgeon, European Theater of Operations, himself wrote to the mother of the first soldier who was blinded in that theater. This letter was later made a part of a form letter sent to the families of blinded casualties when they arrived at an eye center. The letter follows:

DEAR * * *: Your son has had his eyes seriously damaged in the War. On recovering from his wounds and convalescing in the hospital he has been confronted with the fear of blindness, which he has faced with the same manly courage he had when wounded. He has had the most skillful medical and surgical care by American ophthalmic medical officers. Everything possible has been done to save his sight, without success.

The fear of blindness is a very real and ugly thing. Fear can only be overcome by understanding the thing that causes it. The fear of blindness is the fear of utter darkness, a physical darkness that leads to a darkness of the mind. It is also the fear of restricted activity of helplessness. It is the fear of a future with loss of earning capacity. It is also a fear of loneliness, of sentimental pity, of being placed by one's friends into a world apart.

We recognize and understand these fears and overcome them. That is done by training your son to learn to be blind. He is eager to learn and to break his chains. At first he needs help and this comes from many sources, from our Government, from you and from his friends. The Government sees to it that he will get the best training available to teach him to read, to type, to walk around unaided, to play games, and particularly to become experienced in one or more of the many ways a blind person can earn a living, depending upon his capacity; in short to return him to a useful and happy life. This training is done by experienced teachers, many of whom are blind themselves. It can be best done in a sort of school or college where others in the same situation are learning to be blind. Here the stimulus and the guidance of those who are a little farther along the road of independence is one of the greatest advantages of the "college." Haphazard and casual training in the home often does more harm than good. The road, at best, is a long one and to find one's way needs experienced guide, patience, understanding and hard work.

Our Government provides that guide. Your son will have patience and courage to do the hard work of learning the many necessary things. The understanding will come from all of us.

The most important thing you can do when he returns is to treat him as naturally as you can. He does not want pity and sentimentality. He wants to do things for himself and the sooner he does these, the more nearly normal you will all be.

Training takes a long time and varies with the speed of learning. There will be many periods of depression and at times a feeling of hopelessness and futility. There will be times too, when he will feel that no progress is being made. This is the experience not only of those who are learning to be blind, but is common of all learning processes. It is only a sensation and not a fact. In time he will be independent, useful, and, therefore, happy.

You may rest assured that your Government will do everything in its mighty power to restore a fine citizen to a proper pursuit of happiness.

I am writing this letter to you so that you may better understand your son's problem and assist him in its solution. *When he arrives home, greet him as if nothing had happened. Above all, don't embarrass nor discourage him with pity.* With your help he will live his life happily.

I wish for you and for your son all success in your common task of overcoming his injury; and overcome it you can if you refuse to be defeated. He was not afraid when he gave his eyes for his country. You must never let him be afraid while he is getting his vision back through other facilities.

Sincerely yours,

PAUL R. HAWLEY,
Brigadier General, Army of the U. S.
Chief Surgeon.

DEAR * * *: I have been requested by The Surgeon General of the United States Army to write to you concerning your * * *'s condition on arrival in this hospital.

It is the unhappy lot of our generation to bear with all the fortitude we possess the burdens of this war against evil. To some the burden is heavier than to others, but it is the sad duty of all of us to face these hardships with courage and to share with one another the task of restoring physical and mental health, insofar as it lies within our power to do so, to those who have given so much for us.

I regret to tell you that your * * * has sustained grievous injuries to his eyes. In this hospital we have the best facilities and the most expert ophthalmic surgeons to do everything possible to repair the damage to your * * * as the result of war injuries.

I am enclosing a copy of a letter which was sent to the parents of the first soldier to be blinded in action in the European Theater of Operations. It was written by Major General Paul R. Hawley, the Chief Surgeon of the European Theater of Operations, and expresses in classic fashion the thought of the entire Army Medical Corps. It is reproduced here in order to help you, in a small way, to begin to understand the nature of the sad misfortune that has befallen your soldier, to help you to face the problem with similar courage, and to bring some measure of comfort to you in the knowledge that our Government will do all it can to assist your soldier who may have to learn how to be blind.

* * * * * * *

The chief of the eye, ear, nose, and throat section, at Valley Forge General Hospital, wrote as follows to the family of a soldier with some remaining vision and to the family of a hopelessly blinded casualty:

DEAR * * *: As you have already been notified, your son, * * *, has been brought to this hospital as a transfer from Northington General Hospital. This is to let you know that he has been assigned to my care and also for me to give you an account of his condition in more detail than has been possible up to the present time.

He was admitted to this hospital 22 August 1945 having suffered severe damage to both eyes in April 1945. This hospital has been selected for his definitive medical care because the severest damage has been done to his eyes. This installation has been set up as an Eye Center for the United States Army in the treatment of such cases. As regards his eyes, he has a cataract in each eye at the present time. He probably also has foreign bodies inside both eyes. As regards the final outcome after corrective measures have been done, it is indeed too early to promise that he will get any more vision than he has since he is not completely worked up as yet. However, from the initial examination that was done, it seems highly probable that he will have useful vision possibly in both eyes after the cataracts have been removed. Of course there will have to be several operations done on each eye including an attempt to remove foreign bodies if they are present by X-ray. As you already know since you have visited your son, he has also lost a portion of his left

forearm including the hand. I am sure that after he is fitted with an artificial hand, he will do perfectly well. I wish to caution you that it will take a matter of months rather than weeks in treating your son before his eyes are completed surgically.

When you visit your son, please contact the doctor who is in charge of him. This will be Capt. Linus A. Sheehan, ward 14, who will be glad to give you many more details concerning him which I have not enumerated in this letter.

With kind personal regards, I remain,

Very sincerely yours,

M. E. RANDOLPH,
Lieutenant Colonel, MC,
Chief, E. E. N. T. Section.

DEAR * * *: As you have already been notified, your son has been brought to this country after having been severely wounded in action. This is to let you know that he has been assigned to my care and also for me to give you an account of his condition in more detail than has been possible up to the present time.

He arrived at this hospital 28 July 1945 as a transfer from overseas. This hospital has been selected for his definitive medical care because the severest damage has been in the region of his eyes, and this installation has been set up as an eye center for the United States Army in the treatment of such cases. As you know, since you have already seen your son, he has been blinded in action and has suffered a severe deforming wound of the nose. Both eyeballs, as you already know, have been removed. As regards to his course of treatment here, he will be in this hospital for a good length of time, having plastic repair to the lower eyelid on the right and the nose itself. This is indeed time consuming and I do not believe he will be finished with his medical treatment for at least one or one and one-half years.

I fully realize that what I have just said must have plunged you into the depths of despair, and anything that I say in the future in this letter is only of secondary importance to you. However, I would like to direct your attention to the full and successful lives that are led by most blind people. I hardly need to add that our Government will spare no pains or expense in his achievement of this goal.

At present he has the most friendly guidance and companionship that can be selected for him. Naturally, he will become acquainted with every aid and skill that has ever been invented for blind people. Along the lines of these aids, he will be taught the correct way to travel, both inside and outside, with and without the use of a cane. He also will be taught the better use of his four remaining senses which most of us have neglected throughout the course of our normal lives. In this respect he will be taught typing which serves a two-fold aspect, first it increases manual dexterity and secondly, it will be the best method by which he may communicate since writing in a straight line is a very difficult problem for the blind. He also will be taught Braille to increase the sensitivity of his touch and give him a method by which he will read as you and I. As part of our program, he will hear intimate talks from successful blinded people from all walks of life. Our entire program is based on one principle: self independence as a useful citizen to his community and family. Everything that is done for your son will be aimed towards getting him back to a fruitful life.

There is no doubt that you are anxious to know what you can do to contribute towards his happiness and that your immediate concern will be to see him at the earliest possible opportunity. It goes without saying that the affection of his family will be a great help to him at this time, in his hour of greatest need. For truly this time, of all the rest of his life, is the time in which affection and careful guidance are needed to tide him over that bridge between the sighted and the sightless world. However, I wish to caution you against displaying any pity towards him and when you see him, greet him as if nothing serious had happened. Such an attitude on your part will go a long way toward a rebuilding of self-reliance and independence for him. We at this hospital have seen many cases of emotional

breakdowns in front of the patient which necessitated the patient comforting the relatives. Unfortunately the relatives have never seen what happens to the patient's morale after they leave.

If you are planning to visit your son, when you arrive at this hospital please contact the doctor who is in charge of your son. This will be Capt. Linus A. Sheehan, ward 14, who will be glad to give you many more details concerning him which I have not enumerated in this letter.

With kindest regards, I remain,

Sincerely yours,

M. E. RANDOLPH,
Lieutenant Colonel, MC,
Chief, E.E.N.T. Section.

APPENDIX D

Evaluation and Final Statement of Social Adjustment

After the blinded soldier had been in the Old Farms social-adjustment training program for a period of 21 days, all available data concerning him were assembled for study. From this information, it was possible to make recommendations for courses, field activities, and other occupations for the remaining weeks of the course.

At the end of the training period, a final statement was prepared which was a summary of the status of the soldier at the time of his discharge from Old Farms.

Sample copies of the 21-day statement and final statement follow:

TWENTY-ONE DAY STATEMENT

Tentative Conclusions and Recommendations Respecting the Principal Features of the Training Program of:

Rank ..... Name ..... ASN .....

Counselor s/Sgt Everitt Date 5 Nov 45

Address Detroit, Mich. Civilian Worker Aircraft assembler Age 26

OD Emme

Dependents Wife, 3 children Education 7½ years Vision OS Emme

Army Training and Jobs Automatic rifleman

VFGH or DGH Training Braille, Typing, Hobby and Orientation

I. OUTSTANDING OBSERVATIONS:

Significant Facts: ER's eye-lids were torn away when he was injured. As a result his appearance is rather startling due to the absence of eye-lids. He seems to be a friendly, cheerful young man who is making a satisfactory adjustment to his blindness. He is interested in returning to his former employer, Ford Motor Co. He has no vocational goal other than factory work.

Vision: ER does not have travel vision.

Personality Difficulties: There do not appear to be any serious personality difficulties.

Family Situations: ER is married and they have 3 children. Apparently there is a warm relationship in the family.

Attitude Toward Training: ER is anxious to get as much Industrial Skills and factory work as possible during his limited training. He has an 8 week credit for training from VFGH.

II. GENERAL APPRAISAL:

A. Adjustment Evaluation:

Personal: ER is a pleasant, friendly young man who has taken a fatalistic attitude toward his blindness. His physical appearance is marred by the absence of eye-lids. It is understood that his orientation is satisfactory.

Social: ER states that he enjoys social activities. He claims that he is particularly fond of dancing. He seems to be emotionally stable.

Vocational: It is felt that ER's plan to return to factory work is realistic. He has sufficient intelligence and mechanical aptitude to engage in factory work. He does not have any physical limitations other than his blindness.

B. Summaries of Tests:

1. Verbal:

Wechsler-Bellevue: A score of 103 classifies him as Average Intelligence. His work on Digit Span was poor. His best work was done in Comprehension.

Minnesota Multiphasic Personality Inventory: All scores are within normal limits. There is a suggestion of a tendency to present himself in the best possible social light.

Kuder Preference Blank: Primary preferences were in Social Service. All other scores were low, too low to be of any significance.

2. Manipulative:

Mechanical and Manual Group: Mechanical aptitude was average with high average fine finger dexterity, and below average ability in work requiring gross hand coordination. He was average on a simple machine operation; high average in recognition of forms and manipulation of medium sized material, superior in sorting of various shapes and sizes. Tactual sensitivity was average. Muscular coordination and memory were good. He could visualize his pieces and the construction of the Wiggly Blocks. He worked with logic and without waste of motion. He could gauge space and distances accurately.

C. Significant Features of Interviews and General Behavior: There are no significant features other than those noted above.

III. RECOMMENDATIONS:

A. Introductory Statement Concerning Trainee's Plan: ER plans to return to factory work upon discharge. He is particularly interested in the Ford Motor Co. for which he worked 2 years before entering the Army. He is somewhat concerned over the fact that he believes the Ford Motor Co. tends to place blind men in a separate shop. He would prefer to work among sighted employees.

B. Personal and Social Adjustment: There does not seem to be any need for special personal or social adjustment training.

C. Vocational Orientation and Occupational Adjustment: His training should include the following courses:

Braille
Typing
Industrial Skills
Factory Tryout
Woodworking
Hobby Shop
Sports

D. Vocational Training Following Discharge: No recommendations.

For the Training Council:
ALAN R. BLACKBURN, JR.,
Capt, MAC,
Director of Training.

Name

Rank

Date

STATEMENT ON GENERAL TRAINING PROGRAM

The Veterans Administration Vocational Adviser is in agreement with the general training program as outlined in the 21-Day Statement.

A. GLENN MOWER
Vocational Adviser.

OLD FARMS CONVALESCENT HOSPITAL (SP)
FINAL STATEMENT

Counselor _____ Date _____

Name _____ Rank _____ Serial Number _____

The above trainee was granted a Certificate of Social Adjustment by the Training Council on 18 December 1945.

The recommendations of the 21-Day Statement were completed.

His past experience, test results and performance during a factory tryout indicate ER should be employable in factory work.

Statement by Veterans Administration:

The Veterans Administration regional office has been alerted so that preliminary plans regarding vocational training and employment opportunities can be formulated.

For the Training Council:
ALAN R. BLACKBURN, Jr.,
Captain, MAC,
Director of Training.

APPENDIX E

Evaluation of Training Program, Old Farms Convalescent Hospital

Capt. Alan R. Blackburn, Jr., MAC, director of training at Old Farms Convalescent Hospital, evaluated the activities of the hospital as follows:

* * * * * * *

I list here what I consider to be the activities which have proven by experience to be of most value at Old Farms. I shall also point out some of the weak points.

1. As I have said, we found that our *general policies* were sound: that is, the idea of providing *activity* through orientation, sports, and a wide range of [illegible]ctional courses, of "learning by doing"; the policy of creating a *friendly and kindly atmo*[illegible] semi-military nature; the method of placing great emphasis on the individual tr[illegible] each trainee; the system of careful *appraisal* of trainee through frequent consultatio[illegible]esting, supplemented by full records; the plan of *field apprenticeship* which placed a ma[illegible] in actual work in the community while still in school; the policy of 18 weeks: this, in my opinion, was just the right length of time.

2. The *orientation program* was invaluable: at the top of useful instruction. If nothing else is done for a blind man than to teach him to get about well, over half of his adjustment already has been achieved. The prior orientation at VFGH [Valley Forge General Hospital] and DGH [Dibble General Hospital] was excellent, and enabled us to get to advanced work more quickly.

3. *Guidance* was of great importance both social, personal, and vocational. The availability of advice and counsel at all times to any trainees, as well as the systematic dispensing of guidance to them on problems of blindness through regular group discussion, was of great value. I rate this activity second to orientation * * *.

4. A word should be said about the *Records Department.* All work of counselors and instructors is carefully recorded. The final record of each trainee is very complete, and serves in the form in which it is handed over to Veterans Administration as an excellent guide for the trainee as a veteran.

5. I shall not go into detail about the *instruction program* * * *. Suffice it to say that the idea of having many courses (we operate with over 60) is an excellent one because it carries out our purpose of giving the man a tryout by actual experience in many fields. Every important vocational field of the blind is represented: industrial skills, business, agriculture, music, basic skills, academic and professional. The Department of Basic Skills, including typewriting, Braille, and handwriting was strong from the first. We also have at present a strong academic and professional section. This is especially important because we have at least twenty trainees with Group I or high Group II intelligence who may go on to college. In fact it was one of the surprises to find how many men we had who were interested in pursuing courses of an academic nature, or going back to high school or entering college. Advice for a future center would be to guard against exclusive emphasis on hand skills. I believe we kept a proper balance between business, academic, and manual work. Wherever possible, we encouraged trainees to participate in more than one field, in order to have two strings to their vocational bow. Perhaps the most important part of our course concept was the idea of field apprenticeship which showed steady growth from its inception.

Of course, we started as you know in the earliest days with factory placement; but this was extended soon to farm placement; and finally we are now making all types of placement: insurance, gift shops, cleaning establishments, furniture salesmen, greenhouse, etc. This actual work in the outside world while the man was still in our community was of value beyond measure in restoring self-confidence. We had excellent sports facilities, and sports were emphasized. *A blind center should have a swimming pool, bowling alleys, horses,* golf course, gymnasium, fishing, boating – all as a part of the institution. Some of these activities we had to accept as gifts and use transportation to get to. Sports were considered an adjunct to orientation.

6. Cooperation with the Medical Department was essential. I would suggest that in a future center there be even closer cooperation between the Medical Dept. and the Training Division. The Medical Dept. should feel that its advice is needed, and is an integral part of social adjustment. There should be initiative on the part of the Medical Dept. to coordinate the factors of the trainee's general health and handicaps with his accomplishments in the school. In borderline cases of poor adjustment psychiatric advice is sometimes indicated. I think it might be well in a future training center to have a resident psychiatrist, or possibly have a psychiatrist in a nearby community who could be consulted. The psychiatrist need not be a military man. The Army's system of furnishing psychiatric service entailing the sending of the man to a General Hospital for observation is too complex and slow to operate quickly enough. Moreover, the fuss of sending a man to a General Hospital for psychiatric observation has a stigma attached to it which sometimes is harmful to the trainee's attitude. Incidentally, dental and X-ray service should be available at the school. *In fact the school should be only a few miles from the Eye Center of a General Hospital.*

7. The *location* of Old Farms was ideal. A social adjustment center for the blind should be located near industries which use assembly work and power machinery. It would be hard to match the machine-tool industry of Hartford and New Britain in this respect. Connecticut also supplied satisfactory farm placements. New York also made recreational weekends available through Warner Bros. which served a good morale purpose.

It seems to me that there should be only one Eye Center for the blind and that the Training Center should be located only a few miles away. This would permit advanced training while the man is waiting for medical treatment. Proximity of the Training Center to the Eye Center would aid in the twin problems of liaison between hospital and school and irregular intake; understanding of the program by the patients would be better, and transfer of patients would be expedited. The School itself, so far as its general layout, was satisfactory. I favor the isolation we had: it saved us from visitors who nevertheless were often a nuisance. The chief faults of the school were poor lighting and poor transportation. The point on lighting is usually missed in organizations for the blind: nearly half the blind are partially sighted and need the best possible lighting. The lighting, except for some temporary arrangements of drop lighting over machines, has always been inadequate. The heavy stone architecture tends to be depressing. I would prefer for this work colonial architecture airy and bright.

8. *Administration* of such a school must be integrated. OFCH [Old Farms Convalescent Hospital] was set up as a hospital. But in reality it was a school. Many drawbacks resulted from this fact: there was never a proper disposition of funds. For example, certain emergency or unique supplies, or supplies not in the QM Manual, could be ordered only by crafty methods and with considerable delay. We are plagued by changing personnel and inadequate personnel both in numbers and quality. Some of our personnel, of course, were outstanding. Only as late as the start of 1946 did the personnel situation become stabilized with the replacement in the Training Division of EM by civilians.

9. In my opinion trainee discipline was never a serious problem. The only upsetting incidents, and these were comparatively few, were caused by surreptitious drinking on the post. We lacked a "closed ward." A future center should have a room or rooms for sobering up of men who become drunk and disorderly. I am convinced that the decision to

make attendance voluntary was wise. When all services were functioning properly, we had no trouble keeping attendance in the high eighties or low nineties of percent. In morale we thus gained much, and many men attended who would not have under a compulsory plan. In a social adjustment program, compulsory attendance defeats its own ends. For the essence of social adjustment is to encourage self-determination and self-motivation. In civilian life the blinded veteran will be under no compulsion whatsoever to do anything. Giving the blinded soldier a taste of such freedom before he leaves the Army is an aid to his social adjustment. By the way, no one has yet devised a satisfactory method of coercing blind soldiers so far as I have been able to observe. Court Martials are all right for overt acts that cause breakage of property or harm to others, but never get anywhere as an attendance stimulator: they have the opposite effect. I am a believer in stimulation to attend through interest in work, kindness, and friendliness, and efficiency of operation. I have seen it work at OFCH.

The "Gripes Sessions" held every morning at 0830 (except Sunday) were excellent for blowing off steam. They also served as a morning newspaper and open forum. The meeting was an excellent form of group therapy, and much guidance was worked in during these meetings, which were conducted in person by the Director of Training.

The recreation program conducted by the Red Cross was successful and kept a great many men out of mischief, many preferring the dancing on the Post to going into town. The socialization factor was high.

Finally, let me say the School achieved what it did because the trainees were basically sound personalities, the program was properly conceived, and the majority of civilians, EM, and officers were devoted to their duty.

APPENDIX F

Followup Study of Deafened and Hard-of-Hearing Patients

The following report, which is presented without special comment, is derived from the returns of a survey conducted in October and November 1945 of a group of deafened and hard-of-hearing patients who had been treated at the aural-rehabilitation center at Deshon General Hospital during World War II. The survey was conducted under the supervision of Maj. (later Lt. Col.) Edward H. Truex, MC, who was then chief of the aural-rehabilitation center at Deshon General Hospital.

A questionnaire was sent to 468 deafened and hard-of-hearing patients who had been discharged from the hospital to civilian life at least 4 months before the date of the survey. Thirty-three letters were returned as undeliverable, and it is presumed that the remaining four hundred and thirty-five reached the addressees. Answers were received from 261 men, 60 percent of those who presumably received the questionnaire.

The questionnaire consisted of a series of questions to be presented later in this section and the following introductory paragraph:

> Dear Friend: Would you please answer the following questions as carefully as possible and return to me. We are making a survey to find out, in so far as possible, some of the results of our work. Please feel free to write as lengthy a report as you wish on additional paper. What you say will have no reflection on you in any manner whatsoever. All I want is careful consideration to the questions. Your signature is not necessary.

The questionnaire was signed by Major Truex. No provision was made for signatures by the patients, since it was thought that a better response might be obtained if the returns were not signed. Each questionnaire was coded, however, making identification possible.

ANALYSIS OF CASES

The causes of hearing loss suffered by the 261 men who returned their questionnaires are as follows:

Causes of hearing loss		*Number of cases*	*Percent of total*
Otitis media		71	27. 2
High explosives		29	11. 1
Familial causes		15	5. 7
Small-arms fire		10	3. 8
Brain injury		9	3. 5
Other causes		25	. 6
Barotrauma	4		
Congenital causes	4		
Scarlet fever	4		
Otosclerosis	3		
Meningitis	3		
Diphtheria	2		
Measles	2		
Pneumonia	1		
Influenza	1		
Poliomyelitis	1		
	25		
Undetermined origin		102	39. 1

Otitis media was the highest single causative factor diagnosed by the otologists at the aural-rehabilitation center, and it is highly probable that a large proportion of the cases of undetermined origin were also the result of middle ear inflammation.

The type of hearing loss is as follows:

Type of hearing loss	*Number of cases*	*Percent of total*
Conductive	35	13. 4
Mixed-conductive	15	5. 7
Mixed	74	28. 4
Mixed-perceptive	44	16. 9
Perceptive	93	35. 6

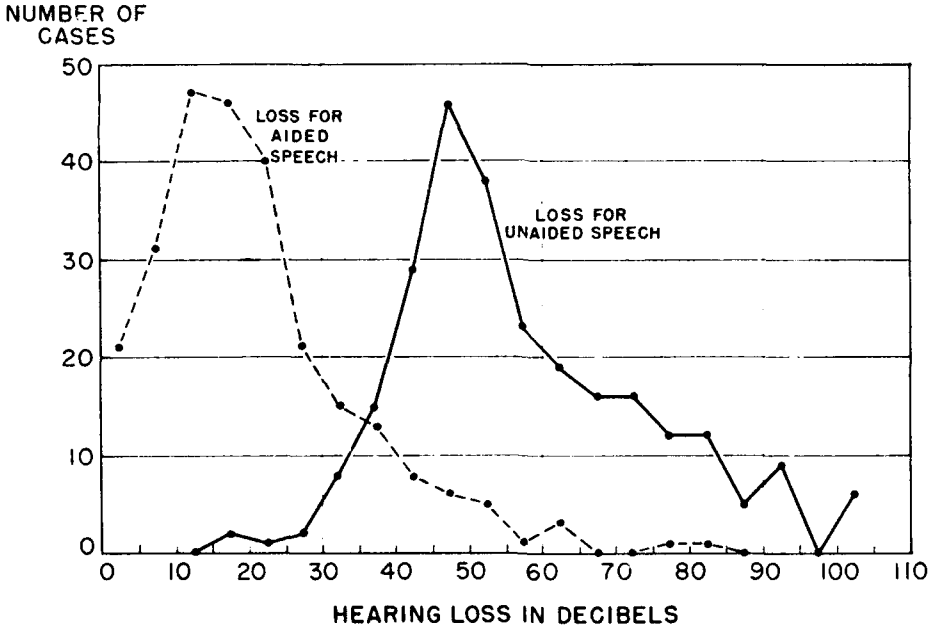
The degree of hearing loss for the group was recorded as decibels loss for speech (spondee) in a free-sound field, as follows:

Hearing loss for unaided and aided speech in 5-decibel increments	*Number of cases* [1]	
	Unaided speech	*Aided speech*
0–4	0	21
5–9	0	31
10–14	0	47
15–19	2	46
20–24	1	40
25–29	2	21
30–34	8	15
35–39	15	13
40–44	29	8
45–49	46	6
50–54	38	5
55–59	23	1
60–64	19	3
65–69	16	0
70–74	16	0
75–79	12	1
80–84	12	1
85–89	5	0
90–94	9	0
95–99	0	0
100–104	6	0

[1] The total number of cases used in this distribution is 259 because clinical data were not available in 2 cases.

The losses varied from 15 to 104 decibels, and the mean loss was 58 decibels. The mode, however, was 48 decibels, the largest single group of men having a hearing loss of this degree. Distribution of hearing loss for unaided and aided speech in 5-decibel increments is shown in the accompanying chart.

Distribution of hearing loss for unaided and aided speech



The duration of hearing loss, tabulated below, is consistent with the etiologic factors identified in the 261 cases: Old otitis media was the predominating etiologic factor, and 70 percent of the group admittedly had had their hearing impairment for more than 3 years.

Duration of hearing loss	*Number of cases*	*Percent of total*
Less than 1 year	33	12. 7
1–3 years	42	16. 1
4–9 years	45	17. 2
10 years and over	126	48. 3
Unknown	15	5. 7

Each of the men had been fitted with a hearing aid (distribution tabulated below) after a rigorous selective program. The mean residual hearing loss for speech with the hearing aids fitted was 21 decibels, which represents an average gain of 37 decibels. The modal point was approximately at 15 decibels, and the distribution ranged from 0 to 84 decibels, as shown in chart on page 575.

Make of aid	*Number of cases*	*Percent of total*
Telex	62	23. 8
Radioear	62	23. 8
Western Electric	57	21. 9
Maico	28	10. 7
Sonotone	24	9. 2
Zenith	14	5. 3
All others	14	5. 3
Beltone	6	
Aurex	4	
Acousticon	3	
Otarion	1	
	14	

ANALYSIS OF RETURNS FROM QUESTIONNAIRE

The various questions in this survey were answered as follows:

1. Do you consider the few months you spent at Deshon worthwhile?

Yes: 258

No: 2

Not answered: 1

2. Have you had contact with societies or organizations for hard-of-hearing people since discharge?

Yes: 37 (14.3 percent [1])

No: 222

Not answered: 2

[1] Here and elsewhere percentages are calculated on the number of replies received to the particular question, not on the total number of replies.

3. Do you feel that people avoid you because you are hard of hearing?
   Yes: 67 (25.7 percent)
   No: 194
4. Do you avoid talking to people because you are hard of hearing?
   Yes: 89 (34.1 percent)
   No: 172
5. Does it embarrass you to wear a hearing aid?
   Yes: 60 (23.0 percent)
   No: 201
6. Were you turned down for any jobs because of defective hearing?
   Yes: 53
   Unknown: 208

Of the 53 men who answered in the affirmative, 11 did not specify the types of jobs for which they had applied; 10 were turned down for factory work, 7 for truck driving, 4 for railroad work, 3 for office work, and 3 for jobs as salesmen. The other 15 men listed riveting, painting, personnel work, airline, food inspector, telephone repair, bakery, real-estate manager, sawmill hand, oilfield, tractor operator, teacher, hospital orderly, fruitpacker, and watchman.

The average unaided hearing loss for this group of 53 men was 57.7 decibels and the average aided residual hearing loss 20 decibels. Neither of these figures represents a significant deviation from the losses for the group as a whole.

7. Is your hearing better, worse, or the same since leaving Deshon?
   Better: 14 (5.4 percent)
   Worse: 51 (19.5)
   No change: 196 (75.1)

Upon receipt of these returns, the clinical records of the 14 men who reported improvement were carefully scrutinized. It was the consensus of the staff that two of the group had had functional hearing impairment which had not been detected during hospitalization.

8. Are you using your hearing aid?
   Yes: 239 (91.6 percent)
   No: 22 (8.4 percent)

The following reasons were submitted by the 22 men who were not using their instruments: Headaches, 4; trouble getting batteries, 3; hearing aid broken, 3; gets along well without aid, 3; instrument too noisy, 3; instrument too cumbersome, 2; instrument makes him nervous, 1; instrument confuses him, 1; and external otitis, 2.

9. Do you consider your hearing aid very satisfactory?
   Very satisfactory: 141 (55.3 percent)
   Satisfactory: 111 (43.5 percent)
   Unsatisfactory: 3 (1.2 percent)
   Not answered: 6

One of the three men who found the aid unsatisfactory wrote that his instrument (a Telex) was so frequently out of order that he "just could not keep it in order." The records showed that with the aid, his loss for speech was reduced from 55 decibels to 20 decibels. The other men who found their aids unsatisfactory complained that they caused headaches. The records showed that their hearing losses were, respectively, 78 and 51 decibels unaided, and 22 and 17 decibels aided. It is of interest that the hearing losses in these 3 cases had existed, respectively, for 10, 15, and 32 years.

It is notable that of the 6 men who did not answer the question, 3 stated in response to the next question (No. 10) that they were wearing their aids more than 9 hours daily. One was employed as a trucking agent, the second was a newspaper dealer, and the third delivered milk. The circumstances suggest that had they answered the question concerning their opinion of their aids, they would have been in the category of those satisfied with them.

10. How many hours a day do you use your hearing aid?

The replies to this question are tabulated as follows:

Daily use—hours per day	*Number of cases*	*Percent of total*
0	13	5.0
1 to 4	45	17.2
5 to 8	60	23.0
9 to 12	54	20.7
More than 12	58	22.2
No response	31	11.9

Of the 45 men who used their hearing aids between 1 and 4 hours a day, 39 were employed in factories, on farms, or in other situations in which a hearing aid is not urgently needed. On the other hand, the use of the instrument for a few hours each day when it is needed makes it just as valuable to men in these situations as to the bank teller who depends on aided hearing 9 hours each day.

11. Do you find that your hearing aid is more useful to you as you gain experience with it?

Yes: 231

No: 16

Not answered: 14

Of the 16 men who answered that they had not experienced increasing benefit from their hearing aids, 6 had previously stated in reply to earlier questions that they were not using the instruments, 4 had answered very satisfactory to question No. 9, and 6 had answered satisfactory.

Of the 14 who failed to answer the question, 5 had responded that they were not using the aids, 1 had expressed himself as being very satisfied, and 8 as being satisfied with their instruments.

12. Do you wear your hearing aid at work?

In response to this question, 35 men (13.4 percent) stated that they were not working at the time of the survey; 226 were employed, and of this number 60.6 percent were using their hearing aids during work.

13. What is your job at the present time?

The answers to this question were too diversified to categorize, a standard nomenclature not having been used.

14. How much benefit did you get from lipreading instruction?

Benefited greatly: 184 (71.0 percent)
Benefited slightly: 72 (27.8 percent)
Gained nothing: 3
Not answered: 2

15. Do you consider lipreading more beneficial to you than the hearing aid?

Yes: 103 (43.6 percent)
No: 133 (56.4 percent)
Not answered: 5

In replying to this question, 20 men were noncommittal, checking both yes and no. The affirmative responses to this question were much more numerous than had been anticipated because of the enthusiasm on the part of the patients for hearing aids rather than lipreading instruction during rehabilitation courses. In retrospect, it is evident that the question as presented is a leading one, suggesting a favorable response for lipreading.

16. Have you taken additional lipreading since discharge?

Yes: 14 (5.4 percent)
No: 246
Not answered: 1

MEDICAL DEPARTMENT, UNITED STATES ARMY

The volumes comprising the history of the Medical Department of the United States Army in World War II are divided into two series: (1) The administrative and operational series, which constitutes a part of the general series of the history of the United States Army in World War II, prepared by The Surgeon General and published under the direction of the Chief of Military History; and (2) the professional, or clinical and technical, series prepared by and published under the direction of The Surgeon General. This is one of the volumes published in the latter series.

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