

*On the Origins of Audiology*  
**AMERICAN WARTIME MILITARY AUDIOLOGY**

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Caring for America's Hearing

American Academy of Audiology • 8300 Greensboro Drive, Suite 750, McLean, VA 22102-3611

# ACKNOWLEDGMENT



The origin of our specialty of audiology is generally acknowledged to have evolved from the rehabilitative services developed by the military during the World Wars I and II. However, we have never had a well-documented historical account to the “birth” of our profession. This monograph on the early beginnings of audiology has been meticulously researched and written by Moe Bergman and will finally fill that void in our literature. Professor Moe Bergman, who as a young military soldier, was present and deeply involved in the development of the military aural rehabilitation services in several major Army hospitals during World War II and provides first-hand descriptions for us of the various early military audiology programs.

Moe Bergman is an internationally noted audiologist who has received numerous honors from many of our professional societies for his contributions to the field. Bergman holds degrees from the University of Illinois (A.B., 1937) and Columbia University in New York (M.A., 1939). Following his military service, he returned to Columbia University to earn a doctorate degree in 1949. He taught at Hunter College of the City University of New York (1953-1976) and was the

first Program Director of the Speech and Hearing Sciences Department. During his Hunter College years, Bergman was an outstanding professor, keen researcher and active leader in audiological issues and programs. As a Professor Emeritus of Hunter College of the City University of New York, he re-located to Tel-Aviv, Israel in 1976 to serve as a Professor in the Sackler School of Medicine where he was ultimately honored with a second Emeritus award in 1985. During his retirement, Bergman has remained active in audiology and devoted considerable time and effort to the development of this valuable monograph.

In this monograph audiologists will find a fascinating account of the development of hearing testing activities used by the military hospital centers of World Wars I and II. With little prior experience, selected military and civilian personnel found it necessary to develop hearing services programs based on aural rehabilitation procedures and the fitting of hearing aids to large numbers of active duty soldiers and sailors. Many of the personnel involved in these early military programs went on to develop academic university audiology programs following their wartime service.

The American Academy of Audiology is proud to publish this historical account of the origins of our profession of audiology. This special monograph will undoubtedly become required reading for students of audiology and hearing sciences and no doubt serve as a useful reference document for all audiologists. We are all grateful and, indeed, indebted to Professor Moe Bergman for providing this legacy of our profession.

Jerry L. Northern, Editor  
*Audiology Today*



Of the many pioneers who were present during the early formative years of the profession during and shortly after World War II, none had a better view than Moe Bergman. As a young recruit in the Army Medical Corps he was assigned to the Aural Rehabilitation program at Hoff General Hospital, Santa Barbara, California. Here he rose to the rank of second lieutenant. When the war ended, after the bombing of Hiroshima and Nagasaki, he was transferred to Borden General Hospital in Chickasha Oklahoma where he served the remainder of his army tour of duty. In 1945 Moe visited the third army installation, Deshon General Hospital, Butler Pennsylvania, on a tour to compare experiences at the three units, Hoff, Borden and Deshon. This experience uniquely prepared him for his life's work in audiology and aural rehabilitation. In his army travels and assignments he encountered many of the early giants in the field; Ira Hirsh, Grant Fairbanks, Raymond Carhart, Leo Doerfler, Herbert Koepp-Baker, Mary Woods Whitehurst, Shirley Stein, William Hardy, Miriam Pauls, Harriet Haskins, Fran Sunday, Louie DiCarlo, John Duffy, Freeman McConnell, Frank Lassman, Elizabeth Nitchie, and many others. This unique perspective served Moe well in his subsequent career. He went on to develop audiology programs at

Hunter college in New York City and more recently in Tel Aviv in his adopted land of Israel.

In this account of American Wartime Military Audiology Moe sketches for us not only the structural and hierarchical frameworks of the various rehabilitation units but the different philosophies brought to the common mission and the wide resources the military was able to muster to help the soldiers and sailors of World War II. He captures the spirit and excitement of those early years in the development of our profession.

James F. Jerger  
Dallas, Texas

# REHABILITATION OF AMERICAN WARTIME HEARING CASUALTIES IN WORLD WARS I AND II

## *the beginnings of clinical audiology*

### AUTHOR'S FOREWORD

It is important for every profession to document its origins. It should be of interest to today's practitioners of audiology to know how the American military "aural rehabilitation" programs for hearing casualties in the 20th century world was practiced what is now known as "audiology." The multidisciplinary organization of personnel and services in those programs and the introduction of electronic equipment for auditory measurements and hearing testing in the WWII centers was a historic landmark in the evolution of clinical audiology.

Every so often there is an allusion in published materials to the origins of the military aural rehabilitation programs of World War II, apparently based upon what the writer may have heard or read from others who were not directly involved in those programs. Fortunately, there are still a few (very few!) of us still extant who were in one or another of those programs from their inception to their termination, and who still have archival material, military records and documents of our service and authorized military travel at the time. The following account draws upon retained memorabilia and documents, memories of participation by the writer and other contacted survivors, and reports published by others immediately or shortly after the war.

Of the three U.S. Army programs established during WW II, the only one that was fully described by an active member of that program was the one at Borden General Hospital at Chickasha, Oklahoma, in a report dated 1 July 1946, and edited by the late Grant Fairbanks (Fairbanks, 6. 1946). I had been a member of the Borden General Hospital program for a short period after active duty at the Hoff General Hospital Center (at which I had been since its inception), was then deactivated, and as a staff member I received a copy of the report which is still in my possession. While departures from the Borden General Hospital procedures at the other centers are noted in the detailed accounts of each center that follow, the report by Fairbanks provides a good framework description of the programs at all three Army centers.

Historical accounts of the aural rehabilitation programs were published at the close of that war and shortly thereafter by those who had central responsibility for them in the Surgeon General's offices in the Pentagon (Morrissett, L.E., 1957; Canfield, N. and Morrissett, L.E. 1947), or who headed the Navy program (Lederer, F. L., 1946), or were personnel in one of the aural rehabilitation centers (Bergman, M., 1957; Scriver, H. 1944; Carhart, R. 1946 a,b,c,d; 1947 a,b), or who were otherwise knowledgeable about the program (Hillman, C.C., 1944). In addition, I retained an operating manual of the Hoff General Hospital Center and various written communications of that period, that will be cited in this monograph.

Moe Bergman, EdD  
Tel Aviv, Israel



*Moe Bergman*

# INTRODUCTION

# & Background

*Many aspects of early audiology in the U.S. had been developed in the civilian leagues for the hard-of-hearing at the beginning of the 20th century. These early aspects of what is now known in general as “audiology” involved new services for adults to complement the ongoing educational programs that were directed at hearing impaired children in previous decades. These new services were introduced mainly by adults who were themselves suffering with hearing impairment, and by teachers of hearing impaired children who were recruited by the former to teach them alternate communication skills. There was also a growing awareness of the increasing numbers of the aging population, many of them with hearing problems. In short, there was a growing realization that impaired hearing occurred not only in children, and not only in severe or profound forms, but that any noticeable hearing loss was a potential impediment to a comfortable and productive life. Clear also, was the threat of hearing loss accompanying modern war caused directly by its noisy machines and greatly enhanced firepower.*

## THE WORLD WAR I PROGRAM

The dangerous implications of hearing loss were recognized in World War I, resulting in the activation of a hearing rehabilitation program at the Army's General Hospital No. 11 at Cape May, New Jersey. Hillman (1944) wrote that “In the first World War, 1 man in 5,000 was discharged for defective hearing”, and “the average annual admission rate to Army hospitals for deafness and defective hearing was approximately 1 in 1,000 per annum.” (“Communication from Statistical Division, Office of the Surgeon General, Oct. 30, 1943”).

The basic rehabilitative treatment at the New Jersey Cape May Center was the teaching of lip reading by eleven teachers who were considered to be experts in that field. (Morrissett, 1957; Hillman 1944). Morrissett (p. 448) quotes Berry, whose summary of the program in 1942 stated that “The men were saturated with lip reading, in an optimistic environment of devoted service.” There does not seem to be any report of the use of electric or electronic amplification in that program.

Despite predictions of thousands of aural casualties, only 108 soldiers were processed through the Cape May Center program in the year of its operation, but apparently hundreds more were recognized after discharge from the Army. By October 1943 the U.S. Veterans Administration had on its rolls for compensation 416 “totally deaf” and 12,397 “partially deafened” veterans of WW I. (Morrissett, p. 447). It was suspected that a large number of the soldiers treated at Cape May had auditory problems before induction into the service, an important observation that we made as well in World War II.

In the quarter century between the WW I program and our programs in WW II, electric (carbon microphone) hearing aids and then electronic hearing aids had been introduced. The emphasis in the rehabilitation programs for adults with hearing impairment was still on the development of new communication skills, including lip reading, “auricular” (auditory) training and speech conservation and correction. In fact, many of the civilian and military personnel of the Army and Navy centers had previously been engaged in the work in leagues for the hard of hearing or similar organizations. The December 1943 issue of the *Bulletin of the New York League for the Hard-of-Hearing* reported that then-Major Leslie E. Morrissett, Chief of ENT at the program at the Borden General Hospital in Chickasha, Oklahoma (later to become the Chief, Otolaryngology Branch, Office of the Surgeon General), “spent long hours observing lip reading classes and discussing the subjects of auricular training, hearing aids and recreation with members of the (NY) League Staff.” H. Davis (1947, p. 12) cites Miriam Pauls Hardy's view of “how admirably speech reading and a hearing aid supplement each other”, clearly equating their contributions to the rehabilitation process.

This understanding of the aural rehabilitation problem, in the World War II programs, was also expressed clearly in the Borden historical report of their program: “The early directives and oral pronouncements specified only hearing aids and lip reading in addition to medical treatment, and it is clear from these statements that the hearing aid problem was regarded almost entire-

ly as one of engineering. Experience swiftly revealed, however, that such treatment did not provide total aural rehabilitation.” (Fairbanks, 1946, p. 28)

An engaging comment by Lederer and Hardy (1946), reporting on the WW II U.S. Navy program, hints at the residual confidence of their staff in the centrality of lip (speech) reading in the rehabilitative process, rather than the hearing aid. Lederer and Hardy found it necessary to express their view that the hearing aid should be fitted as early as possible in the rehabilitation program, since “The gains in confidence and the ease of communicative and social adjustments more than compensate for any lag of effort to master speech reading.” (ibid p. 437)

## THE WW II PROGRAMS

In anticipation of a large number of aural casualties of the tremendously enhanced explosive arsenals and of the noisy new war machines, such as tanks and sophisticated aircraft in WW II, the American Army designated three General Hospitals as specialized centers for hearing treatment in May 1943. The later chiefs of the program in Washington, D.C., Canfield and Morrissett (1947) credit otologist Dr. Walter Hughson as “the chief inspiration for the armed-service programs...” (Ibid p. 322)

The three hearing treatment centers were placed geographically, at Hoff General Hospital in Santa Barbara, California; Borden General Hospital in Chickasha, Oklahoma; Walter Reed General Hospital in Washington, D.C. The Walter Reed Center, which was the first designated for the purpose in the

spring of 1943, and was headed by Lt. Col. Marion B. Mobley, was soon moved from that busy hospital to the Deshon General Hospital in Butler, Pennsylvania. After activation of the Army centers in the autumn of 1943, the Navy set up its center at the U.S. Naval Hospital in Philadelphia in the spring of 1944.

In circular No. 81, issued Feb. 23, 1944, the War Department directed that “every case in which the impairment of hearing within the conversational range (256-2048 cycles per second) or a loss of 3/16 or below to a whispered voice when an audiometer is not available, in a case of stationary or progressive deafness free from acute inflammatory aural disease, will be transferred to a hospital designated for the rehabilitation of the deaf at the earliest practicable date” (Hillman, 1944).

The three Army centers processed about 10,000 patients, while the Naval Aural Rehabilitation Center admitted about 4,000 (Canfield and Morrissett, 1947; Morrissett, 1957). Many of the soldiers seen at the centers had pre-service hearing loss, undetected mainly to the inadequacy of the hearing tests administered to the draftees at the induction centers. In fact, even some men with long-term losses were accepted. (Canfield & Morrissett, 1947). For example, data assembled at the Hoff General Hospital Center, and probably representative of the remaining military centers, revealed that the hearing problem was of recent onset (presumably during service) in only 15% of the patients, while 65% had hearing loss for over 4 years and 31 % for over 12 years! (Morrissett, 1957 p. 458).

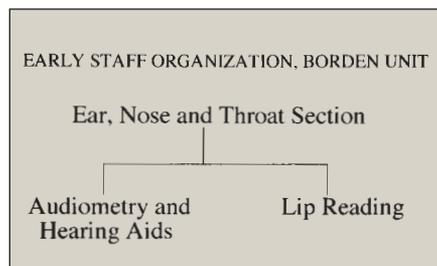
### THE ARMY CENTERS

Major Leslie E. Morrissett, who had been at the Borden General Hospital since January 1943, was later appointed chief of the combined ENT Section and the program in Aural Rehabilitation in the summer of 1943. (Fairbanks 1946, p. 3). In July of 1944 Morrissett was transferred to the Surgeon General’s Office in Washington, D.C. to head the entire Army hearing treatment program.

The Army programs in California, Oklahoma and Pennsylvania began receiving patients at about the same time in the Fall of 1943, and after several feverish months devoted to the recruitment of both military and civilian staff, and the organization of hearing test and hearing aid selection procedures, the Surgeon General’s Office arranged a conference of the medical heads and key personnel of the three

Army Centers to meet at Hoff General Hospital, February 2-4, 1944 to coordinate their functions. Morrissett later referred to this meeting as a “Conference on Rehabilitation of the Hard of Hearing” (Morrissett 1957; pp 449-450). I recall that in addition to the chief otologist from each Center, the nonmedical military staffs were represented by Francis Sondag, who had been first at the Walter Reed Center and then transferred to Butler, Pa., Raymond H. Hull (unrelated to our present distinguished colleague of the same name) of the Borden Center and myself representing the Hoff Center. I do not have any official summary of that conference, but in a brief published summary of the conference, written in 1945-46 (but not published until 1957), Morrissett includes among our conference’s recommendations, “Hearing aids should be furnished to all deafened and hard of hearing in the Army instead of, at present, only to men with hearing impairment incurred in [the] line of duty.” (Morrissett, 1957).

There was agreement by the conferees that there should be a general uniform plan for the three hearing centers, but that personnel should be free to study and institute new procedures. Later, after a visit to two of the centers, in June 1944, the Chief of the Surgical Consultants Division of the Surgeon General’s Office recommended that there be uniformity of activities and standardization of equipment at all of them. This is the recommendation that led to the appointment of Major Leslie E. Morrissett to Washington to coordinate the various Army programs.



*Early staff organization of the Hearing Program at Borden General Hospital located in Chickasha, Oklahoma.*

As noted above, the beginning of the individual programs in 1943 continued to resemble the WW I program, except with the addition of the pure tone audiometer and the introduction of the body-worn hearing aids of the period. The organization chart that

would reflect one of the programs (Borden) after activation in late 1943 and early 1944 would include, under the Ear, Nose and Throat Section of the hospital just two sub-sections: Lip Reading and Audiometry and Hearing Aids. (Fairbanks 1946, p. 34)

Later the organization and activities became considerably broader, as we will see in the sections on the individual centers. As they developed, each Center reflected the experience and creativity of its particular staff. There were continuing attempts to unify the procedures after the February meeting at Hoff General Hospital. For example, in June 1945, Major Martin, our medical chief at Hoff, and I traveled to the Central Institute for the Deaf, the Deshon General Hospital and the Borden General Hospital to observe their programs.

### THE NATIONAL DEFENSE RESEARCH COMMITTEE ROLE IN THE WW II MILITARY AURAL REHABILITATION PROGRAMS

An important influence on the evolution of similar procedures for the selection of hearing aids, and in fact on the routine of auditory testing at the three Army centers and the Navy program, was a research contract with the National Defense Research Committee of the Office of Scientific Research and Development, in which Section 17.3 was set up with the Harvard University Cruft and Psycho-Acoustic Laboratories and the Central Institute for the Deaf, in St. Louis, for the “Study and Development of Instruments to Aid Militarily Incurred Deafened.” (NDRC 1944)

The Harvard contract was for the period beginning 5/25/1942, with the “Official Investigator” being S. Smith Stevens, while the CID contract was to be in effect from 10/15/1943, with S. Richard Silverman as the Official Investigator. Some of the representatives of the Harvard labs who made visits to our Hoff unit or who were otherwise helpful in correspondence with us included C.V. Hudgins (also with the Clarke School for the Deaf at that time), Douglas A. Ross and Clifford T. Morgan. It was after Dr. Morgan’s visit that some of us received direct officer’s commissions in the Army, but while we did not know whether that was related to his visit or not, we strongly suspected a direct connection.

Today’s audiologists will be surprised

at how much of what the Harvard Cruft and Psycho-Acoustic Laboratories developed at that time established the basis of research and clinical procedures in our field, e.g. speech audiometry, electro-acoustic analysis of hearing aids, and probe tube measurement.

The NDRC projects included the following:

(The following descriptions are based upon progress reports, in typed correspondence in 1944 and 1945, from the Cruft and Psychoacoustic Harvard Laboratories to Major N.A. Martin, Chief of Aural Reconditioning Unit, Hoff General Hospital, Santa Barbara, California.)

#### **Diagnostic instruments**

Central Institute for the Deaf. Measurement of the overall response of electroacoustic instruments to be used in the military hearing treatment centers.

#### **Evaluation of hearing aids**

Harvard University, the Cruft Laboratories. Then-current hearing aids were evaluated for their electro-acoustic characteristics, including amplifier response and overload characteristics at various tone control settings, frequency response and impedance characteristics of hearing aid receivers (which were physically separated by a cord at the time) and battery drains. They developed molded eartips to be used with small probe tubes that could be attached to a condenser microphone for the measurement of frequency response characteristics. They reported that this approach exposed two differences from the measurements obtained with a rigid 2cc coupler, a greatly reduced low-frequency response, and a broader resonance peak, probably due to leakage around the earmold in an ear, and possibly also to damping effects in the ear. (As with all history, it is sobering to realize that a relatively “new” technology, such as *in situ* probe tube measurements was conceived so many years ago.)

#### **Speech audiometry**

At the Harvard Psycho-Acoustic Laboratory: “Standard deafnesses” were simulated by selective attenuation and noise masking. When it was demonstrated that articulation scores were similar to those of patients with similar hearing losses, researches were confident that the articulation tests that were being developed in their lab for hearing aid selection procedures would

be appropriate for the purpose. They continued subsequently to produce a modified word test, recorded through a high-pass filter for testing patients with high-tone losses. (Author’s note: It is curious that now, over a half-century later, the possible clinical usefulness of such a highpass filtered word test is apparently of little interest to audiology clinicians.)

The NDRC project’s purposes were stated to be “to test the physical characteristics of various commercial hearing aids (Cruft Laboratory), to evaluate such aids using articulation procedures with simulated deafness in normal subjects (Psycho-Acoustic Laboratory) and with hard of hearing subjects (Central Institute for the Deaf); to develop new tests and instruments for the evaluation and fitting of hearing aids (Harvard Psycho-Acoustic and Central Institute for the Deaf); and to validate and apply the results of such studies to individuals who have suffered hearing loss in military service (Deshon General Hospital). Raymond Carhart, who was then the Chief of the Acoustics Department at the Deshon Center was apparently the main Deshon link in the NDRC project.

#### **Measurement of the physical characteristics of hearing aids**

This was carried out at the Harvard Cruft Laboratory on commercial hearing aids of the time. In an early assessment of the use of rigid couplers for the calibration of earphones, measurements obtained with them were compared with information from loudness-balancing.

#### **Development of word lists for hearing tests with and without hearing aids**

Word lists were developed at the Harvard Psycho-Acoustic Laboratory for testing the understanding of speech (“articulation testing”). The special property of these lists was stated to be that in normal ears their homogeneity resulted in “the rapid transition of the entire list from unintelligibility to intelligibility with a relatively small increase in loudness” (Ref. July 1, 1944, letter from NDRC, p. 3-49)

The lists, containing the bisyllabic “spondee” words, were designated as “Auditory Test No. 9”, in which groups of six words were recorded at successively decreasing intensity levels for arriving at a threshold for speech perception. The lists were also recorded at increasing levels for the measurement of loudness tolerance (“Auditory Test

No. 10”), and through a 4000 Hz high pass filter (“Auditory Test No. 11”) as a measure of detecting high-tone hearing loss.

As reported by Egan (1948), the PB-50 word lists for tests of speech discrimination were also developed at the Harvard Psycho-Acoustic Laboratory at that time. The word lists were re-recorded at the Central Institute for the Deaf and then evaluated on hearing impaired and normal listeners for their appropriateness as measures of speech perception and annoyance in the fitting of hearing aids. A cautionary note on the use of these tests in the hearing aid fitting routine was published by the personnel of the Harvard Laboratories, where the tests were developed. In their article on the selection of hearing aids (Davis et al 1946) they concluded that hearing aid selection on the basis of test results with such lists were inconclusive and arbitrary. Despite such reservations on the tests they had inspired, the wartime hearing aid selection procedures persisted in audiological practice for many decades.

Because of the unusual circumstance of relatively large budgetary support and the freedom to engage or assign a broad range of trained personnel, the WW II auditory and hearing programs set a remarkable example of services to adults with hearing impairments: the first multidisciplinary teams (medical, education, rehabilitation, engineering, psychology, social work, etc.); highly-structured rehabilitation programs; the introduction and development of specialized electronic equipment for diagnosis and assessment, speech audiometry, hearing aid selection procedures; extensive and intensive counseling and training in the use of hearing aids; and insights into “psychogenic” deafness.

It is also notable that the publication of one of the first books on audiology in the 20th century, Davis’s first edition of his *Hearing and Deafness* textbook (1947), was inspired by the WW II military programs, with many of its illustrations taken at the wartime hearing centers.

The trailblazing contributions of those centers were recognized by President Harry S. Truman in his White House message on the occasion of National Hearing Week, Aug. 1947, when he stated that “Today, in peacetime, we are continuing the extensive research in behalf of persons with impaired hearing, initiated by the armed forces during the war” (Truman 1947).

# THE WW II HOFF GENERAL HOSPITAL HEARING PROGRAM

*Santa Barbara, California*

*The following account is partly anecdotal, but augmented by center archives and personal army orders that are still in my possession. Details of the program are contained in the manual "Administrative Routine and Standard Procedures for the Rehabilitation of the Deafened and Hard of Hearing", (Hoff General Hospital 1945). My retained copy may be the only one that is still extant. In military organizational fashion, all procedures were prescribed in detail and specific forms for each procedure were required to be completed. Unfortunately, page numbers are irregularly entered, in my copy of the manual, apparently because of the inclusion of the many required forms to be completed, so the page references given in the following are only approximate.*

The Hoff aural rehabilitation center was activated on September 6, 1943 at Santa Barbara, California, with the arrival of the first teacher of lip reading, Helen Scriver. (Scriver, 1944). The hospital was built around a number of Quonset barracks-like huts, which was apparently the army's pressured response to the outbreak of the two-front war in Europe and the Pacific.

I arrived at the center early in November 1943 as the first soldier assigned to the Program, having been transferred to it shortly after my basic training and specialized instruction in radio electronics and communication. My assignment to the new Hoff program was related to my previous education and work experience with school speech and hearing disorders, and was arranged by Major Walton E. Barton, a psychiatrist who was the assistant director of the Reconditioning Division Office of the Surgeon General of the Army, and who was the first central director of the army aural rehabilitation programs. (Morrissett 1957, p. 449)

The Hoff program was then organizationally under a Col. Fuchs, who was the chief of the medical rehabilitation section of the hospital. When I reported for duty to the Colonel he charged me with organizing the rehabilitation program (I was later dubbed Administrative Coordinator) but cautioned me that the soldiers would be receiving the Zenith A-2 hearing aid, since his "father had one and it helped him". Still one of the bulky "body" hearing aids, with a separate battery pack containing the heavy "A: and "B" batteries, the Zenith aid was being sold at the price-shattering cost of \$40 (\$50 for the more advanced model), where-



*Miss Helen Scriver and a group of lip readers at Hoff Hospital*

as other aids were selling at the time for about \$125-150.

The medical direction of the program then proceeded from the medical rehabilitation physician to an ophthalmologist (Captain Herman Faier) and finally to an otolaryngologist, Major Norvil A. Martin, who had returned from a harrowing trek as medical

continued to head the program until it was dismantled following the Hiroshima bombing.

More staff, both civilian and military were quickly added, and by the time of the February 1944 meeting of the heads and selected staff of the three army centers at our Hoff Center we were essentially under full operation.

The delineation of responsibility and duties in the Army required each staff member to have an official title, with positions in the military following army protocols of rank.

For example, I arrived at Hoff as a private in November 1943, but in recognition of my assigned organizational tasks I was soon promoted to the rank of corporal (technician 5th grade, which was about the lowest rank above that of private), so that I would be permitted to spend nights off the base with my wife ( a privilege denied to privates at that base). Later, however,

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*Advertisement for the \$40 Zenith hearing aid of the time.*

officer of a U.S. army contingent that had slogged its way over the Owen-Stanley mountains in New Guinea. Major (later Lt. Colonel) Martin



*ENT and Aural Rehabilitation staff, Hoff General Hospital. Ira Hirsh is looking over the head of Don Caziarc (in light-colored uniform) who is seated in the center of the front row, next to Lt. Col. Norvil Martin (with moustache), Chief of the clinic.*



*Lt. Col. Norvil A. Martin, Chief of Clinic, pinning new 2nd Lt. bars on Joe R. Shinpaugh, Jr. as newly commissioned 2nd Lt. Moe Bergman looks on (Hoff Hospital)*

I was named Administrative Coordinator of the program, after receiving a direct commission as an officer (along with other colleagues at the three army centers) Next, I was the Acoustic Officer, responsible for the development and supervision of testing and hearing aid fittings until the arrival of 2nd Lt. Ira J. Hirsh, who was assigned to that position. My next official title was Project Director of the Aural Rehabilitation Program. Entering the program later was the transferred line officer, Captain Donald R. Caziarc, who became the ranking officer in charge of the Hearing Program in October 1945.

### PROCESSING OF PATIENTS

The patient's stay at the hospital was for eight weeks.

**FIRST WEEK:** Upon admission to the hospital he was quartered in the active rehabilitation ward (as distinguished from the general sickness wards), and a ward medical officer

took a history and did a physical examination, with particular attention to eye complaints. In addition, a visual acuity test was required, evidently related to our emphasis on lip reading in the rehabilitation program. (As an example of the distinction of patients by their military rank, the Administrative Routing and Standard Procedures manual stated that all *officer* patients were to be interviewed and examined only by the Chief of the Section.)

The soldier was then given an audiometric test, followed on the same afternoon or the next morning by a second audiometric test. An impression of the ear for an ear mold was then taken, he was interviewed by the clinical psychologist, and examined by otologists in the ENT clinic, before being assigned to the rehabilitation program.

He met with the Administrator, who registered him for the program and prepared the work sheets. He was then interviewed in turn by the supervisors of lip reading, auditory training and speech. Vocational or educational counseling might be recommended by the Administrator to the Reconditioning Division for such counseling and for assignments in job therapy or apprentice training.

Another interview was with the Red Cross counselor, who arranged personal and family services as needed.

Also in the first week the patient attended discussion groups conducted

by members of the aural rehabilitation staff. These discussions were on such topics as: a) Orientation, led by the Aural Rehabilitation Officer and focusing on the purposes, etc. of the program; b) Medical Aspects, by a medical officer; c) Hearing Aids, a three-hour orientation to the tests to be conducted in the sound-isolated (test) rooms, to the types of hearing aids, their care and use, and an opportunity to see and informally try several different types of the then-available aids, and d) Lip Reading, an orientation stressing its importance, with a resume of the lip reading program. As required, a group hearing aid was used for these discussions.

At a weekly clinical conference, attended by the otologists, the psychologist, the Aural Rehabilitation Officer, the Acoustic Officer and the Project Director, each new patient who had been admitted during the week was interviewed, and after that group interview decisions were made about the patient's rehabilitation program. (A "game" we enjoyed indulging in at those conferences was guessing from the patient's speech the region of the country he came from. I recall becoming quite pleased with the skill I acquired at the game).



Corporal Bergman fitting hearing aids at Hoff Hospital

**SECOND WEEK:** The patient continued receiving individual lip reading instruction, begun during the first week, and reported to the test rooms for complete hearing tests, followed later in the week by the hearing aid fittings with the various aids. (Note: In the early days of the program before we received equipment, the "fitting" was essentially entirely subjective, with the patient trying out each model in the hospital corridor, wards and recreation areas).

During this week all patients had

instruction in "speech retention", while those with diagnosed speech problems received individual speech/voice correction. Those who were considered to be in need of group or individual auditory training were assigned to those classes.

In addition to the instruction just



Miss Ruth Bartlett with the first class for group instruction in lip reading at Hoff Hospital

described, the soldiers participated in the following activities: educational and orientation programs, physical reconditioning, G.I (army) movies and news reels, and group discussions relating to other rehabilitation, i.e. vocational guidance, occupational therapy and job therapy, such as apprentice training on and off the post.

**NEXT WEEKS:** The schedule remained the same for the third week, but in the fourth week group lip reading was begun. No further change occurred in the sixth and seventh week, but in the eighth and final week the soldier's evaluation papers were completed and submitted to the Chief of ENT, where a preliminary disposition was decided, with further decisions being made by a Disposition Board, that could recommend reassignment to duty or separation from the service.

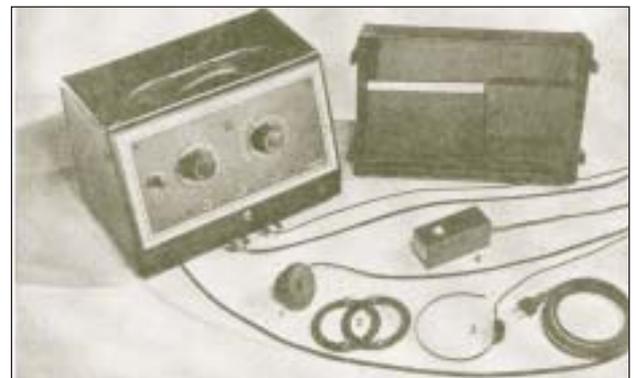
### THE HEARING TESTS

For the audiometric examination there were two types of audiometers available, the Maico D-5 and the Western Electric 6Bp.

Western Electric had first produced for general distribution a portable version (Model 2A) of their innovative rack-mounted model 1-A audiometer, then followed it with the models 6A and 6Bp (portable). It had to be frequency calibrated by the examiner by adjust-

ing a small potentiometer to extinguish a hum when the frequency dial was set to 0. The Hearing Loss dial was to be set to the engraved zero reference value for the frequency being tested. (There was no automatic internal adjustment for the normal threshold curve on that model.) To move from the air conduction test to bone conduction the examiner was instructed to "place the index ring #126A over the Hearing Loss potentiometer" and to "read the figures on this ring for losses." (Once again, the zero HL reference for each test frequency was at a different position on the index ring.)

Today's audiologists will be interested to know the approach to masking



The Western Electric 6BP audiometer. The knobs on the control panel, from left to right, are tuning adjustment, frequency selector, and intensity control (attenuator). The accessories in the foreground behind the power cable include the receiver (1) (with sponge-rubber face); two accessory ring-shaped scales (2) for the attenuator (to give readings for bone conduction); and the bone-conduction receiver (3) with its metal head-band. The small box (4) with the push-button is the masking attachment.

at that time, over a half-century ago. The manual's instructions are therefore reproduced verbatim:

Masking is necessary in many cases in air conduction tests, in addition to bone conduction tests. Routine practice has shown that the safe procedure in audiometry is to test the better ear first. If the threshold for the poorer ear is found to be 40 decibels or more lower (i.e. poorer) on the audiometric test than that for the better ear, the subject may hear the test tones with the better ear. If this occurs, masking should be used while testing the poor ear. When masking, provide the patient with a headband to hold the air conduction receiver used for masking the opposite ear of the patient, thus leaving the hand free so that the patient can signal whether or not he hears the test tone. The examiner may set the masking tone just loud enough to effectively mask out the better ear. (Hoff General Hospital, 1945, p. 20)

In somewhat greater detail for the masking procedure with the WE 6B audiometer, the examiner was to use the Pilling-Witting Masker (a separate device) as follows: (ibid p.20)

4. Attach the power cord from masker to power outlet.
5. Turn on masker but place "Normal - Add 50" switch at "Normal"
6. Place receiver on patient's ear not being tested.
7. Use from 70 to 80 decibels of masking noise, depending on the degree of the patient's loss to bone conduction.

(Note: I do not recall whether the external masker was referenced to SPL or HL.)

An interesting entry was concerned with tinnitus. "When the patient says he has a head noise it will be up to the examiner to ask the subject the apparent pitch, loudness, and quality of tinnitus, by going over the entire range of the audiometer until the patient signals that he has the tone equal to his head noise."

## LIP READING

Of the eight weeks of the program, the soldier received 22 to 24 lessons in the first four weeks with the same instructor. This was followed by 22 to 24 groups lessons, with instructors being rotated weekly. The students were grouped according to their lip

reading ability, but age and educational background were also considered. It was recognized that there were more than one "school" of lip reading at the time and the instructor was free to follow any method that he or she favored, but "in the interest of uniformity" there was a framework built around groups of phoneme movements, such as:

First week: Introduction of vowel sounds ah, o, oo, a, e with

1. f,v, (ph optional)
2. m,b,p
3. s,z, soft c
4. sh, ch, j, soft c
5. review

Later, group lessons included practice material related to jobs "of interest to special students in the group" and "general topical practice material, preferably related to fitting the student for civilian life" (ibid p. 24).

## AUDITORY TRAINING

While the detailed instructions refer to "auricular training", this section of the 1945 manual is headed "Auditory Training" indicating that the name was in the process of change. (Hoff Report 1945, p. 28)

The first aim of auditory training was stated simply as "the integration of auditory, visual, and kinesthetic stimuli for quick and accurate interpretation of sound...with emphasis on the perception of auditory stimuli." (ibid p. 29) Auditory stimuli were listed as speech, everyday sounds, gross sounds, music and "other complex external auditory stimuli." Visual stimuli were presented as "speech reading" (a term also in the process of change from "lip reading") including gestures, expressions, etc. and printed texts and notations for both music and speech. Auditory intolerance problems received special training attention and a variety of human voices and articulation patterns formed the practice material, both in isolation and over backgrounds of noise and competing speech.

As soon as the hearing aid was provided, the patient was given a diagnostic test of aided speech reception by the auditory training staff. In addition to a list of carefully selected words, the test included sentences, phrases and proverbs, in graded difficulty. A low

performance on these tests led to assignment for individual auditory training instruction. Auditory training was also designed for those with a low threshold of acoustic tolerance or large discrepancies in inter-ear thresholds. All patients were entered into the class program.

Stimuli were mostly recorded on reel-to-reel tapes, including everyday sounds (e.g. birds, traffic noises, etc.), spoken phrases, parodies of proverbs and word lists, instruments of the orchestra, song recordings for practice with such variations as soprano, alto, tenor, baritone and bass voices, recorded stories (e.g. anecdotes and jokes), prose, poetry and drama for prolonged and intensive listening, and, of great emphasis, selective listening of speech over competing noises and talkers. It is interesting to note also that two telephones of the hospital were equipped with amplifiers for use by our patients.

## SPEECH RETENTION AND CORRECTION

Every patient was interviewed by the Supervisor of the Speech Department. This interview included conversation, the reading of a short paragraph and of sentences designed to reveal articulation errors. Patients whose speech and voice were judged to be good were then assigned to a "speech retention" class, the objective of which was "to emphasize the importance of maintaining these." Speech sounds that might be vulnerable to change because of hearing loss received special attention and minor articulatory errors were corrected. Voice characteristics, such as volume, placement, resonance, breath control and pitch were considered, and this training concluded with applied practice through group and individual reading aloud, short talks, radio skits and short plays.

Significant speech and voice problems were addressed in individual and small group therapy sessions. (Even at that time "before" and "after" recordings were made, with the introduction of the revolutionary "Mirrophone", which replaced the disk-cutting technology with a magnetic recording on a reel of metal tape.)

## HEARING AID FITTING

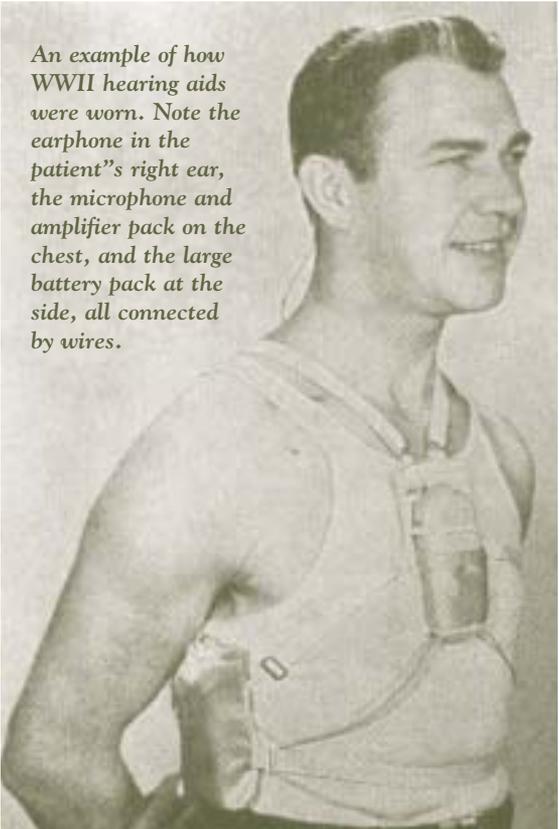
Ear canal impressions were taken shortly after the soldier was admitted to the hospital, and the ear mold was fabricated in the hospital's dental laboratory.

Following an audiometric workup, the patient was scheduled for the test suite where a sound field unaided audiogram and spondee threshold were determined. The spondee threshold was measured using the recorded version of the spondee lists ("Articulation Test No. 9") provided by the Harvard Psycho-Acoustic Laboratories.

Since the bulky body-worn hearing aids were then always monaural, the rule for determining which ear to aid was based on the following guidelines:

IF.....	THEN FIT
a. there is approximately a uniform, moderate loss bilaterally	a. the ear not used on the telephone.
b. the poorer ear is better than 70 dB loss in the speech range	b. the poorer ear.
c. the poorer ear has greater than 70 dB loss in the speech range	c. the better ear.

When the fabricated ear mold was ready the patient returned for comparative hearing aid tests with 6 or 7 different instruments, using the same fabricated mold for each. (It should be recalled that all hearing aids of the period terminated in a separate mini-earphone to which the ear mold was to be attached.) The Center stocked only those models



An example of how WWII hearing aids were worn. Note the earphone in the patient's right ear, the microphone and amplifier pack on the chest, and the large battery pack at the side, all connected by wires.

of hearing aids that had been approved by the Council of Physical Therapy of the American Medical Association. At that time, all hearing aids utilized two batteries, an "A" battery (1 1/2 volts) and a "B" battery usually of 45 volts.

The gain control of each aid was adjusted by the patient as the examiner read sentences taken from the Fletcher-Steinberg lists (developed at the Bell Telephone Laboratories), from a distance of 10 feet; then the patient's aided sound field thresholds for pure tones and spondee words were measured as before. The patient was then asked to rate the aid under test as "clear" or "blurred", "natural" or "mechanical", and "quiet" or "noisy". The results of the comparative tests were then submitted to the Acoustic Officer for selection of the hearing aid to be dispensed. The patient was authorized to draw batteries from the

Property Officer, was individually advised in the early use of the aid and given a printed set of instructions on the care of the instrument. An additional handout contained clear instructions to members of the patient's family, such as "Do not shout at him", "Attract his attention first before speaking to him", "Do not talk to him in the dark", "Do not say the same words to him over and over again... think of some other way to express the same thought.", etc. The patient was then instructed to report to the hearing aid technician several times thereafter for checks on the fabricated ear insert and the operation of the hearing aid. Weekly meetings were held for new patients during which frank discussion of the problems associated with hearing aid use was encouraged. Continuous follow-up and guidance were provided in the auditory training classes. Upon discharge from the hospital the patient was given a month's supply of batteries.

**OTHER SERVICES**

*Psychologist.* During the first week of the patient's stay at the Center he was interviewed by the clinical psychologist. If psychosis was suspected, he was referred to

the psychiatrist; if war neurosis or other psychoneurosis was noted, he was scheduled for psychotherapy; personal problems, such as family relationships, vocational, etc. were addressed and counseling given. A battery of tests was available for use as indicated, and included measures of intelligence (Army Basic Intelligence Test), personality (Minnesota Multiphasic Test), vocational counseling, etc.

**NON-ORGANIC DEAFNESS**

Complaints of non-organic deafness by military personnel during wartime had been identified in various combat armies in World War I and earlier as hysterical deafness. Reports were published about the experience in the American army (Loeb, 1918), in the British army (Hurst and Peters, 1917), and in the Russian army (Zilboorg, 1944). Interestingly, Zilboorg reported that 50 percent of the cases of deafness acquired under combat conditions were found to be of psychological origin. These authors also cited experiences in the French and German armies. This history and the related diagnostic approaches are reported in detail by Bergman (1957).

An engaging view of this problem was reported by Lederer, a Naval otologist who headed the U.S. Navy aural rehabilitation program in WW II and William Hardy, also of that program (Lederer and Hardy, 1946). They described cases of what they termed "situational deafness", in which there was a true initial deafness related to exposure to blast and noise, with the symptoms lasting enough to send the victim to the medical officer. With the passage of time the hearing problem cleared up; but by then, fearing an accusation of malingering the patient continued to complain, becoming more involved in the deception. Lederer and Hardy reported that an understanding attitude by the medical officer could clear up the problem promptly.

**NARCOSYNTHESIS**

Until February of 1945 the suspicion of possible psychogenic deafness or outright malingering in some of the soldiers evoked various diagnostic attempts, with uncertain results, at the Hoff Center (many of such ad lib approaches are described in the report of the Borden Center). The Hoff

Center program's staff psychologist learned of the successful result achieved in the treatment of wartime neuroses in the Eighth Air force in North Africa (Grinker and Spiegel, 1944) and suggested the use of that approach for uncovering the deafness version.

Ninety-three patients of the Hoff Center aural rehabilitation program were then studied under *narcosynthesis*, with marked "improvement" of their hearing, while such "improvement" occurred spontaneously in 17 others who knew of the "treatment". By the end of the program in 1945, it was estimated that 126 (9% of the total admissions of 1,375 patients in the program) had presented questionable complaints of deafness.

The term "narcosynthesis" was coined by Grinker and 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", and under the influence of the drug the ego, freed from the repressed emotions "can approach the traumatic situation and, to some extent, deal with it" (Grinker and Spiegel, 1944).

Briefly, the narcosynthesis session proceeded as follows: In the 3-4 days preceding the narcosynthesis session the patient was given strong suggestion that he would hear normally after it. If it was thought that the hearing problem was entirely non-organic the patient was introduced, both individually and in group sessions, to other patients who had "recovered" completely after the "treatment."

In the narcosynthesis session the anesthetist administered a light dosage of thiopental sodium (between 0.25 and 0.8 gm. in a 2.5 to 5% solution), and as it was being delivered at the rate of 0.1 gm per minute he was instructed to count aloud backward from 100 to 1. Generally he became incoherent by the time he counted down to 50, and the anesthetist controlled the rate of injection so that the patient was kept at the desired light

state. Meanwhile the patient was asked simple questions and assured repeatedly that he would recover his hearing, while simultaneously ethyl chloride was sprayed at the external ear, producing local temperature changes and the assurance of restoration of hearing was repeated. Additional questions concerned the patient's traumatic or other military experiences, his family and other matters deemed of possible concern to him. The suggestive procedure was then repeated for the second ear.

As the patient became fully conscious, he was repeatedly assured that his hearing had returned to normal. Immediately he was tested by audiometry and whisper and live voice and recorded speech perception tests. The testing was repeated in the following days, and emotional or other symptoms that had emerged during the pentothery were addressed psychologically. Occasionally a patient appeared to revert to his deafness when he realized that he was responding normally. Willful simulation was suspected in such cases.

An interesting result was seen in three patients, whose test results and history indicated a true long-term sensorineural hearing loss, and who had asked to undergo the "treatment" in the hopes of improvement. They were accepted, in order to note the effect of the suggestion. Following the narcosynthesis all reported that they heard "much better" in such situations as the movies, listening to radio and other difficult situations. Testing revealed no change in their actual hearing.

During one period of data collection, 42 of 76 patients who were revealed to have functional hearing loss in these sessions had a history of pre-induction hearing loss, over half for more than 10 years. It may be that in some of these a functional component was overlaid on an organic base. Only 12 patients of the 76 had actually been in overseas combat.

Twenty soldiers who had been admitted to the program after blast concussion and whose hearing had returned after narcosynthesis had reported complete loss of hearing after the blast, followed a few days later by

partial recovery, then complete loss again after a few more days. These may have included cases of Lederer and Hardy's "situational deafness."

A final comment about psychological (or "psychogenic") deafness which can easily be overlooked if the clinician is not alert to it. After the application of the narcosynthesis procedure at the Hoff Center, the staffs at the Army Center at Deshon and the Navy Center in Philadelphia, where few cases of psychogenic deafness had previously been noted, began to report increasing prevalences, until by the end of 1946 their numbers were "in close agreement" with those of Hoff (Canfield and Morrissett, 1947, p. 335).

### ADDITIONAL SERVICES

Other supportive and therapeutic services were furnished by the Red Cross worker, occupational therapists, psychiatrist, physiotherapist, and the physical reconditioning program, and counseling was available from an Educational Officer, a hospital-based representative of the Veterans Administration and the Classification and Separation Officer, who cooperated with the psychologist in determining whether to return the soldier to active duty or to recommend separation from the service.

### FOLLOW-UP

In an attempt at self-evaluation of the program's effectiveness, the Chief of the Aural Rehabilitation Program at Hoff sent out a questionnaire to the soldiers who had been discharged from the service after leaving our program, asking for such information as vocational adjustment, success in using the hearing aid, the usefulness of their lip reading skill, and their evaluation of the army rehabilitation program.

I could find no record of the replies or their analysis, although Canfield and Morrissett reported that "In both the Army and the Navy units, ninety-four per cent of those who replied (to a questionnaire) stated that they had been benefited by the course and were still wearing the hearing aids which were supplied." (Canfield and Morrissett, 1947, p. 321)

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## APPENDIX 1: HOFF GENERAL HOSPITAL HEARING PROGRAM STAFF

The personnel of the Hoff General Hospital Hearing Center as of September 1945:

### MEDICAL STAFF

(NOTE: MC: Medical Corps; MAC: Medical Administrative Corps; S/Sgt: Staff Sergeant)

- Lt. Colonel Norvil A. Martin, MC, Chief, EENT Section and Aural Rehabilitation Program
- Major S.N. Palevsky, MC, Assistant Chief, EENT Section
- 1st Lt. Arthur C. Jones, Jr., MC, Ward officer
- 1st Lt. Legrande J. Audion, MC, Ward officer
- 1st Lt. Willard Parker, MC, Ward officer

### AURAL REHABILITATION STAFF

- Capt. Donald R. Caziarc, MAC, Aural Rehabilitation Officer
- Capt. James H. Moore, Clinical Psychologist
- 2d Lt. Moe Bergman, MAC, Project Director
- Tec 4th grade Jacques P. Penn, Administrator
- S/Sgt Franklin A. Buck, Jr., Assistant Administrator

### TECHNICAL STAFF

- (Responsible for audiometrics and hearing aid selection; ear molds, instrumentation and equipment maintenance.)
- 2d Lt. Ira J. Hirsh, Acoustic Officer
- Tec 3d Grade Ransom I. Bovee, Instrumentation and Maintenance
- Sgt. Russel Wilson, Ear molds, audiometrician
- Cpl. Francis S. Dunning, Hearing aid selection
- Tec 5th Grade Walter E. Riefler, Hearing aid selection
- Tec 5th Grade Vesta T. Nelson, Audiometrician

### EDUCATIONAL STAFF

- Lip Reading Instructors (NOTE: It is apparent from the following that, as in the WW I program at Cape May, New Jersey, the most numerous staff in the WW II centers was for lip reading.)
- Helen Scriver, Supervisor, Lip Reading Department

### Lip Reading Department, Civilians:

- Echo F. Allen
- Marian J. Anderson
- Orville Armstrong
- Ruth M. Bartlett
- Virginia Baughman
- Cecilia Boslett

- Franc(i.e ?)s E. Davidson
- Dale Gay
- Frances H. Downes
- Margaret Manning
- Mildred Kinnier
- Natalie Nelson
- Alice Stubbins
- Althea Woodruff

### Lip Reading Department, Military

- 2d Lt. Joe R. Shinpaugh, Jr.
- 2d Lt. Emily E. Lintner
- Tec. 4th Grade Helen A. Demarais
- Tec 4th Grade Gertrude Kibler

### Other sections

- Agnes C. Riley - Supervisor, Speech Department
- Mary H. Crumbling, Speech Correctionist
- Alice Johnston, Speech Correctionist
- Ocea H. McMurry, Speech Correctionist
- Dorothy W. Scolton, Speech Correctionist
- Martha Turner, Speech Correctionist
- Mary W. Whitehurst, Supervisor, Auditory Training Department
- Dorothy Y. Lawrence, Auditory Training Instructor
- 1st Lt. Selma L. Larsson, Auditory Training Instructor
- Jacqueline Genthon, Assistant Psychologist
- Wilma Kelly, Diversional Activities
- Jocelyn Siem, Red Cross Social Worker

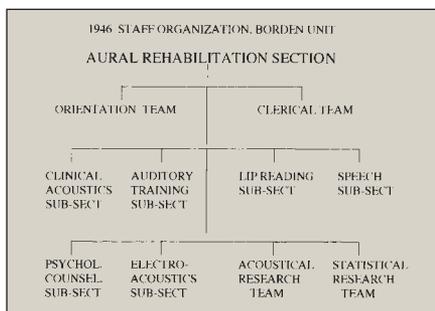
# BORDEN GENERAL HOSPITAL AURAL REHABILITATION PROGRAM

*Chickasha, Oklahoma*

The following account is based on a final report prepared by Captain Grant Fairbanks and the staff of the Center (Fairbanks 1946). In addition, after the bombing of Hiroshima brought the war in the Pacific to an end, the Hoff Center program was closed, and I and others of its personnel were reassigned to the Borden Center. Some of the following, therefore, also includes personal recollections of that program. The Borden Hospital was designated as a Hearing Center in May, 1943, and the Chief of the Ear, Nose and Throat Service, Major Leslie E. Morrisett, was later appointed also the Director of Aural Rehabilitation.

## PERSONNEL

The first of the aural rehabilitation staff arrived in November 1943, and included 2d Lt. Raymond H. Hull and Private Edward L. Scouten of the military, and civilians John A. Morris and Sara Laurenzi. From that initial staff of four the number of personnel grew rapidly, until it peaked at 81 members in September 1945. The staff was augmented considerably by the transfer of some of the Hoff program's staff after Hiroshima.



Final staff organization of the Hearing Program, Borden General Hospital, Chickasha, Oklahoma.

In the course of the program, from the end of 1943 through 1946, 118 persons were members of the staff, of whom 93 had a Bachelor's degree, 40 of them with the additional M.A. degree and 6 with a Ph.D. degrees. (The graduate training had not been in audiology, since there were no university-degree programs in audiology until after the war.)

## PROCESSING OF THE PATIENT

After admission to the hospital and then to the Aural Rehabilitation program each soldier underwent a medical work-up by the ward officer and in the

ENT clinic. Recommendations were made for the non-medical phases of the program. Concurrently the patient was processed in the Aural Rehabilitation Section, where the program was explained, questions answered and appointments made for examinations. The patient was given an orientation booklet to the program.

## ASSESSMENT OF HEARING AND COMMUNICATION PROBLEMS

The initial workup included, in addition to the hearing tests described below, tests of visual identification of speech to determine lip reading ability, speech sound inventory and voice check, psychological appraisal, and an interview by a representative of the Convalescent Reconditioning Service. Tentative recommendations were then made about a hearing aid, lip reading, auditory training, speech instruction and counseling. (Fairbanks, 1946 pp 11-12) If a hearing aid was recommended, the patient was referred to the Dental Clinic for the fabrication of an ear mold, and a temporary loaner hearing aid was provided.

## AUDIOMETRY AND HEARING TESTS

Hearing tests consisted of pure tone air and bone conduction thresholds and the required "tests of the distances to which standardized spoken and whispered voice were recognized, the latter being expressed as fractions of 20 feet and 15 feet, respectively." (ibid p. 46). At first there were no acoustically designed rooms available for the audiometry tests, but later construction provided isolated chambers.

The tests of spoken and whispered voice recognition, however, "were carried on in one or other of two quiet rooms 30 feet long and untreated acoustically (since) it was felt that as long as this comparatively primitive method of testing was used by regulation, elaboration of the facilities would not improve the tests sufficiently to warrant the expenditure." (ibid p. 47) Despite their reservations, however, efforts were made to standardize the whisper-voice testing by having just one male tester, speaking "short factual questions, five or six words in length, of simple thought and unrelated one to the other (e.g. Who was the first president? What color is an apple? How many eyes do you have?)" They found the test-retest reliability with the same tester voice to be "very high" (ibid p. 48).

The report stated that "the most easily standardized, most reliable and valid tests of speech perception are those secured under conditions of electrical stimulation with 'canned' speech or metered 'live voice' as a stimulus and with the results expressed in decibels above the normal threshold." But such measurements were made only for hearing aid selection (ibid p. 47).

Audiometer calibration appeared to be a problem. The report states that the audiometer of issue (the Maico D-5) seemed to be satisfactory for air conduction measurements but poor for bone conduction, where "the main difficulties were unreliability and lack of sufficient power." A borrowed Sonotone Model B audiometer was judged to have a satisfactory bone conduction system, so measurements were

done on the Maico for air thresholds and on the Sonotone for bone conduction. "These instruments were re-calibrated on normal ears and correction factors applied to the manufacturer's calibrations." (ibid p. 47). By late 1945, two more advanced Sonotone (Model 20) audiometers became available and both air and bone condition measurements were made on them.

It was recognized that the need for masking was "of considerable importance", but "no satisfactory commercial masking devices were available or known." Toward the end of 1945, "thermal noise generators were devised and constructed locally for this purpose" (ibid p.48). No guidelines for masking procedure are included in the reports.

The percentage of hearing loss was determined through computing the average of the loss at "512, 1024, and 2048 cycles (and) multiplying the mean hearing loss for air conduction by 0.80 according to the prescribed method." (ibid p.48) (Note: As I recall, this was based on the fact that the maximum hearing level on the audiometers was 120 dB, so a Hearing Level threshold of 120 dB would constitute a 100% loss.)

The problem of malingering and psychogenic deafness, an area of concern at each of the military programs, was approached at Borden General Hospital by a method they labeled the "dark room treatment", in which the test room was darkened and "the spoken and whispered voices were determined for the ear in question. The technician, by shuffling his feet, attempted to mislead the patient to believe that he was approaching or receding, but kept his voice at the same level all of the time." Another method involved slipping a second technician into the darkened room to walk audibly toward the patient as the stimuli were given from the original distance. Other techniques involved attempting to obtain an audiometric shadow curve in claimed unilateral deafness, and variations of the Stenger test using two audiometers (no 2-channel audiometers were available at the time).

The account of the Hoff Center program contained reference to the use of narcosynthesis with the assistance of

the controlled injection of sodium pentothal in cases of suspected malingering or "hysterical" deafness. This procedure was later applied at Borden by the program's psychologist in the hospital's Neuropsychiatric Section.

### THE INDIVIDUAL AURAL REHABILITATION PROGRAM

Each patient was assigned to one of the following programs:

- a. *Standard full program*, which consisted of the dispensing of a hearing aid, 4 weeks of auditory training, 8 weeks of lip reading instruction, speech instruction and psychological counseling, if indicated.
- b. *Abbreviated program*, which included the same, except that the instruction was only for 4 weeks or longer, determined upon the duration of the hearing loss, previous experience with a hearing aid and "superior lip reading ability."

### SELECTION OF HEARING AIDS

Since it was considered important to equip the soldier patient with a means of communication as quickly as possible, hearing aid selection was performed within the first two weeks following the patient's admission. In case of delay, a stock hearing aid (Zenith A3A) was loaned with stock ear molds as soon as it was determined that he was to receive an aid. In addition to restoring communication speedily, this was found to raise morale and to prepare for the hearing aid fitting procedure. Of the almost 2400 hearing aids issued at Borden, 200 (8%) of the aids were bone conduction heavy loss (mostly Sonotone).

As at the Hoff Center, early experience with commercial laboratories for fabricating ear mold inserts was unsatisfactory, so arrangements were made with the hospital dental clinic to make them out of standard dental acrylic. This was a very successful alternative, with a minimum delay for delivery, and permitted rapid adjustments and re-fabrication when necessary.

From the outset, the hearing aid selec-

tion procedure was independent of commercial vendors, although some of the staff had been commercial hearing aid dispensers and had useful knowledge to apply.

In late 1943, hearing aids were evaluated in a conventional hospital office, with informal tests using spoken voice at various distances. Testing equipment was later constructed at the Central Institute for the Deaf following design cooperation between the technical staff of the Borden Center and CID and with the assistance of personnel of the Psycho-Acoustic Laboratory of Harvard University. This was made possible by the army's contract with the National Defense Research Committee (NDRC). The new equipment was installed at the Borden Center in July 1944, "after which time selection procedures became more uniform and more objective" (ibid p. 53). The equipment was rack-mounted, and included an amplifier, volume indicator, oscillator and talk-back amplifier. Pure tones were delivered by a Maico D-5 audiometer and speech recognition was by micro-



First Lt. Raymond H. "Woody" Hull calibrating the rack-mounted equipment used for two-room audiometry during the early days of the Borden program.

phone ("live voice") or recordings from a turntable. Additional microphones and loudspeakers were installed in both control and test rooms.

By October of 1945, new equipment added a static noise generator, a thermal noise generator, and a two-channel amplifier, with associated pre- and power amplifiers, all topped with a

control console that permitted mixing of signals as desired.

Various types of speech materials were used, but the staff favored test transcriptions provided by the Psycho-Acoustic Laboratory of Harvard University. The Borden report states that the use of those transcriptions “will not be described in this report, because of their complexity and the variation in their use” (ibid p.53). (For details on these PAL tests, e.g. Auditory Test No. 9, see the previous section on the Hoff Center.)

The updated equipment and two-room test suite permitted hearing aid comparisons as follows: After an unaided binaural sound field pure tone audiogram was taken (“with careful standardization of the patient’s head position”), the following tests were run using speech materials expressed as dB “above the normal detection threshold”:

- a. Speech detection level;
- b. Identification level: level in dB at which the test words could be repeated;
- c. Preference level: level in dB which the patient’s preferred level for listening to the words; and
- d. Tolerance level: the tolerable maximum level in dB for speech before discomfort.

Then the first trial hearing aid was fitted on the patient and the gain control adjusted as the patient signaled his preferred level for listening to speech at a distance of six feet. The four speech tests described above were then administered, plus one test for identification in noise in which the speech signal was accompanied by a mixture of thermal and static noise, “approximately 40 decibels above the normal threshold.” For those hearing aids that provided the expected gain, additional tests included the aided sound field pure tone threshold audiogram, with the gain control at the established setting, and the identification threshold, with the gain control at maximum.

Subsequent trial hearing aids were subjected to the same routine, with their gain controls set as follows: Test words were introduced through the loudspeaker at the detection level of the first aid, and the control of each of the following aids was set to equate to the same detection threshold.

If a review of the test results failed to

differentiate the trial hearing aids, the patient’s opinion was solicited with regard to each aid’s clarity, freedom from noise, naturalness of sound, etc. Since all hearing aids at that time were body-worn and could be easily identified by looks, they were kept out of the sight of the patient as far as was possible, “to prevent bias because of such factors as size, beauty, reputation, etc.” (ibid p. 56)

After the early months of the program, the Army Medical Purchasing Office arranged the acquisition of a quantity of hearing aids under contract with five different hearing aid manufacturers, so the hearing aid issued to the soldier after the hearing aid selection procedure was the one that had been used in the tests. In addition, the staff had found several additional useful models, e.g. for bone conduction and certain high gain and power instruments, a small supply of those aids was stocked in the center.

#### AUDITORY TRAINING AND HEARING AID FOLLOW-UP

As the hearing services program evolved, some members of the auditory training staff were assigned to hearing aid supervision and worked closely with the hearing aid selection staff and with the psychologist. They provided basic instruction and counseling in the use of the aid and distributed general and specific product literature for guidance. A week after the aid was issued the patient was recalled for follow-up and additional interviews were arranged as necessary.

Upon discharge from the hospital

the soldier was seen again, given a supply of batteries and replacement receiver cords and instructed about the Veterans Administration services or, if returned to duty, given a letter of instruction to his new service station.

Both group and individual auditory training were given to improve listening ability with the hearing aid. Stimuli included recordings of everyday sounds, such as those of automobiles, restaurants, crowds, etc., many of which were obtained from a company specializing in recordings for radio broadcast. Much of the recorded material was acquired also directly from advertising agencies and broadcast stations. These provided a variety of voices and sound effects. Telephone use was a featured part of the auditory training program, and special practice rooms were set up, including a means for two-way telephone conversations to be listened to by the entire class for analysis.

Although only monaural hearing aids were then in use, practice in auditory localization was attempted, with



Master Sgt. Louis M. DiCarlo conducting an individual auditory training session at Borden General Hospital using a desk model hearing aid.



Group auditory training with a group hearing aid at Borden Hospital. The instructor at the far left is John K. Duffy.

selectable loudspeakers placed at the four 90 degree positions.

*Listening Laboratory.* In addition to the group sessions the patients had the opportunity of spending hours in the listening laboratory, in a comfortable and pleasant environment, and in which recorded materials, graded in difficulty, were available for listening practice.

The Fairbanks report contains a very detailed summary of the auditory training procedures and materials, emphatically endorsing the positive contributions of the auditory training program to the continued successful use of the hearing aid.

### LIP READING INSTRUCTION

As in the hearing rehabilitation program in WW I, the major staff commitment in the WW II programs was to lip reading instruction. This was clearly a carry-over of the pattern in the civilian leagues for the hard-of-hearing at the time.

The teachers' instruction plans at Borden changed over the years from 1943 to 1946 from exclusively individual lessons to group instruction in which the use of voice was permitted for the instructors, and finally to "Sight-Hearing," in which the patients used their hearing aids, while motion pictures were employed, and recorded background noises were introduced as background competition. While the lessons were organized around individual phonemes the practice material involved continuous speech, such as sentences, games, stories, etc.

During the first weeks the instruction was given under favorable conditions of light and distance, but the advanced instruction was designed to increase the complexity and difficulty of the spoken material and included variations in the environmental conditions. In a typical lesson the instructor gave a short talk or read a story, following which the class members were encouraged to enter the discussion, with emphasis on quick shifts of attention from one face to another. This provided added opportunity of reading speech from different angles. Further difficulties were introduced by changing the available light and with the instructor obstructing part of the face.

### SPEECH CORRECTION AND CONSERVATION

All new patients were checked for voice and speech defects and those with problems were assigned to individual training or, for mild defects to group instruction. Many patients were assigned to both. A feature of the speech correction program was the use of "a phonograph recorder" and the newly-introduced magnetic tape recorder. These provided a record of before and after progress.

As at the Hoff Center, speech conservation (originally called speech "insurance") instruction was given "to prevent speech defects before they exist." (ibid p.72) The purpose was to develop awareness of speech, particularly anticipating the possible effects of hearing loss on speech production, and drew heavily on the use of public address systems, recordings, musical instruments, etc. Details of the speech conservation instruction, although from the viewpoint of another center (Deshon), were provided by Carhart (1947).

The Borden center received a limited number of patients who did not have hearing problems but who were in need of help for speech and voice problems, such as stuttering, laryngectomy, aphonia and dysphonia due to paralysis, articulatory defects related to maxillo-facial wounds, etc.

### PSYCHOLOGICAL AND VOCATIONAL COUNSELING

It was evident that the entire Aural Rehabilitation Program, centered as it was on the quick restoration of effective communication, provided the most immediate psychological support for our patients. An initial psychological assessment of each patient was made as a guide in his rehabilitation. This led to the development of a Hearing Attitude Scale (ibid p 76), which was intended to uncover such problems as inaccurate self-appraisal, depression, over-optimism, emotional tension, job worry, sensitivity, tendency to cover-up, and social withdrawal. The scale was scored for each patient and changes diagrammed over the period of the program. The results were used to decide whether the patient required individual help beyond the group counseling of the program, or special educational or

vocational counseling, or had such significant emotional problems that referral to the Neuropsychiatric Section of the hospital was indicated.

[Unfortunately, although the Borden report (p 75) refers the reader to its Appendix I, apparently for a copy of the Scale, my copy did not include it.] This scale, devised by the psychological team of the Borden program, may have been one of the first, if not the first, of the hearing handicap scales that were subsequently developed in our field. At the end of the program the Hearing Attitude Scale was re-administered to all patients.

Other standard psychological measures were employed, if indicated, and an original word association test and a sentence completion test were developed as supplementary assessment instruments.

Group psychological counseling included "situational practice", in which, for example, a patient appeared at a party of his "friends" for the first time wearing a hearing aid, or was applying for a job. The emphasis, in such sessions, was on facing the problems of withdrawal from social activities, sensitivity about using the hearing aid, etc.

### PROGRAM FOR PATIENTS WITH MILD LOSSES

A feature of the wartime programs was the attention to those in whom mild hearing losses and unilateral losses received aural rehabilitation services even though hearing aids were not indicated. At the Borden Center a special two-week program was devised, with instruction given three hours each day, five days a week, and additional individual instruction or counseling as required. This program included lip reading, auditory training, and sight-hearing lessons, with emphasis on listening under adverse environmental conditions, localization problems, etc.

### RESEARCH

A staff member was designated to head this activity, which consisted of both tabulative and experimental projects, and focused on such activities as audiometric testing, hearing aid fittings, testing lip reading ability, patient flow data, etc.

The testing of voice and whisper recognition as a function of distance, required by army regulations, continued to be evaluated for validity and reliability. There was almost constant study and evaluation of the procedures for the selection of hearing aids as these methods were repeatedly altered and improved.

I am grateful to Grant Fairbanks for this very detailed report on the Borden Hospital program. The night before his untimely death in an airplane heading

to a meeting, some years after the war, my wife and I enjoyed dinner with him at a restaurant in White Plains, New York, reminiscing about the war-time experiences we shared. Grant had been a recognized child prodigy, who applied his brilliance and creativity to the field of communication and its disorders. His contributions at Borden General Hospital during the war and to our field, particularly during his many years of research at Iowa University, made it a privilege to have been associated with him.

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## APPENDIX 2: BORDEN GENERAL HOSPITAL HEARING PROGRAM STAFF

Borden General Hospital aural rehabilitation staff from activation through deactivation (in the order in which they joined the program)

### MILITARY

1. 1st Lt Raymond H. Hull
2. T/3 Edward L Scouten
3. 1st Lt Robert T. Baughman
4. 2nd Lt Elizabeth Benson
5. M/Sgt Louis M. DiCarlo
6. T/4 John Kester
7. T/3 Glenn Beaty
8. T/3 Ben Straus
9. Capt Grant Fairbanks
10. 2nd Lt Kenneth W. Braly
11. 2nd Lt Urie Bronfenbrenner
12. Sgt Eugene Morrill
13. Maj Luther G. Ramer
14. T/4 Freeman McConnell
15. T/5 Mary Mills
16. 2nd Lt Robert D. Boyd
17. Sgt Cyril Radcliffe
18. Pvt Richard Weaver
19. T/4 Grover McMillan
20. 1st Lt Roger Bardsley
21. 1st Lt William E. Miller
22. Pvt Howard Burns
23. T/4 Robert F. Sucek
24. 1st Lt Windell Fewell
25. 2nd Lt Kenneth Beighley
26. Capt Donald R. Caziarc
27. T/4 Gertrude Kibler
28. 2nd Lt Joe R. Shinpaugh
29. 2nd Lt Moe Bergman
30. Capt James H. Moore
31. 2nd Lt Mary Emily Lintner
32. Pfc Victor A. Johnson
33. T/3 Helen DaMarais
34. Cpl Francis Dunning
35. T/3 R.I. Bovee

### CIVILIANS

1. John A. Morris
2. Sara Laurenzi
3. Lois Jean Weida
4. Mary L. VanBebber
5. Anne Purdy
6. Isabelle Demarest
7. M. Evaline Rae
8. Virginia K. Fletcher
9. Morton Offett
10. Mary Elizabeth Steen
11. Dorothy K. Topping
12. Doris Thiesen
13. Mary Jane Ambrose
14. Fern E. Haggen
15. John K. Duffy
16. Margaret V. Eckhart
17. Marjorie M. Nerenberg
18. Josephine Walker
19. Armin D. Turechek
20. Robert Harrington
21. Gwendolyn Cline
22. Lois Silver
23. Helen Harris
24. Jacqueline Keaster
25. Douglas Wheeler
26. Mary Jane Bope
27. Faye Ola Bush
28. Bettie J. McClelland
29. Marguerite Schmelter
30. Dorothy Ayers
31. Barbara Smith
32. Sue Scott
33. Elaine Szymoniak
34. Katherine Kelley
35. Chester M. Shaffer
36. Lois Laverne Carson
37. Harry Wise
38. Dorothy Nielsen
39. Dorothy Downey
40. Mildred Jones
41. Nestor A. Wickman
42. Mamie Dickerson
43. Mary Jane Sloan
44. Glenn J. Taylor
45. Yvonne Gowan
46. Agnes Cota
47. Edward Shulman
48. Kay Shepherd
49. Lola McMullen
50. Mary Leonard
51. Juliane Peterson
52. Susanna Baltzer
53. Waring J. Fitch
54. Clayton T. Knowles
55. Nora Jeanson
56. Jessie Lillard
57. Delwin B. Dusenbery
58. Dorothy Dennis
59. Georgia Barger
60. Lucille Ford
61. Avah Compton
62. Louise Winter
63. Jeanne Baker
64. Betty Shepherd
65. Jean Kelley
66. Janet F. Watson
67. Jacqueline Giles
68. Ruth Doering
69. Mary Hindman
70. Sylvia Dossey
71. Betty Black
72. Nancy Ann Morse
73. Patricianne Baldrige
74. Anne Gormley
75. Ruth Zucker
76. Billie Holderman
77. Bobby L. Nabors
78. John H. Wiley
79. Frank M. Lassman
80. Everett T. Curry
81. Maurice Whitlock
82. Colleen Christian
83. Betty B. Wallace

# US NAVY HEARING SERVICES PROGRAM

*U.S. Naval Hospital, Philadelphia, Pennsylvania*

*The World War II aural rehabilitation program at the U.S. Naval Hospital in Philadelphia served members of the Navy, the Marine Corps and the Coast Guard. It was organized by Captain Francis L. Lederer (MC), an otolaryngologist, and supervised by Lt. Commander Herbert Koepp-Baker, Ph.D., as director of non-medical services. (Lederer and Hardy, 1946)*

In the staff organization of the non-medical services, the Director oversaw a Supervisor of Speech and Hearing Re-education, who in turn was responsible for the auditory training and speech reading instructors and the speech correctionists. The Chief Acoustic Technician had a staff consisting of other acoustic technicians and an Electronic Technician, and the Clinical Psychologists had responsibility for psychometrists and articulated with the Red Cross worker, while the liaison with outside organizations for post-service follow-up, such as the Veterans Administration, was the responsibility of the Educational and Vocational Counselors.

The structure of the program was based upon the premise that “the rehabilitation of the person with a hearing disability is primarily a non-medical operation” (ibid, p.431).

Referral to the Navy program was based upon the audiometer threshold of 30 dB HL or more in the better ear “within the conversational range” (ibid p. 431), although there were not many pure tone audiometers available in the field at the time, and the “conversational” voice and the whispered voice tests of hearing were still being widely used in pre-induction examinations, as discussed below. It is not surprising, therefore, that about 40% of the patients referred to this treatment center had hearing losses before they entered the service, a reality that was recognized in each of the military aural rehabilitation units.

## INTAKE PROCESSING

On entry the patient received a general physical examination, followed by an otological examination and history-taking. If otosclerosis was diagnosed

the patient would be sent to the U.S. Naval Hospital in Bethesda, Maryland, which was the designated center for the accepted surgery for that pathology, Lempert’s “fenestration nov-ovalis.”

Following the medical work-up a battery of hearing tests was administered, including the conversational and whispered voice tests, the tuning fork Weber and Rinne tests (“to clarify the problems of accurate diagnosis”) (ibid p. 434), and audiometric and speech reception tests. The authors state flatly that “the conversational voice test is so variable as to be essentially meaningless”, but they offer a defense of the whispered voice test, conducted “with the use of residual air” as being seemingly valid for measuring high frequency loss. (ibid p. 434) In cases of suspected simulated hearing loss the Lombard and Stenger tests were employed.

The Navy center introduced the concept of “situational deafness”, by which was meant the sequence of events following the patient’s complaint of loss of hearing while exposed to gunfire or other explosions. Although his complaint was verified by examination and hearing tests in the field and at the various processing facilities before he reached the aural rehabilitation unit, the hearing loss may have lasted only a short time, during which he became increasingly committed to it as the examinations accumulated. By then, fear of censure or suspicion of malingering

entered as an enmeshing factor. While the Lederer/Hardy report insists that this occurred only seldom, it does provide one possible interpretation of functional (“non-organic”) deafness.

In addition to pure tone audiometry, speech reception was measured in a free field with a “hearing evaluator”, a two-channel instrument developed through the assistance of the National Defense Research Committee, whose role in the military aural rehabilitation units is described elsewhere in this report of the WW II programs.

In addition to the medical and audiologic examinations the patient met with the Red cross worker and the



*Hearing aid ear inserts were fabricated in the dental labs of the hospitals in which the aural rehabilitation clinics were located.*

specialist in educational services and prevocational training, and then with a departmental psychologist.

An impression for an ear mold was taken if the use of a hearing aid was indicated. As a start in the communicative re-training the sailor was interviewed by a speech reading instructor, who graded his natural ability in that skill. Finally, the newly-

admitted patients met as a group for a lecture by the Director of non-medical services on the psychology of deafness and problems of mental hygiene.

### THE AURAL REHABILITATION PROGRAM

Patients remained in the program for 5-6 weeks, during which they received instruction in speech reading, auditory training and speech production. They spent five hours each week in these activities, in sessions designed separately for those with "marginal", "moderately severe" or "profound" hearing losses. The teaching sessions were conducted in classrooms, each of which was equipped with a group hearing aid and a built-in glass booth for speech reading instruction with full voice.

### THE SPEECH READING PROGRAM

The "speech reading", or "lip reading" methodology employed in the Navy program was different from that employed in the Army programs. This difference reflected the variations of methodologies that were current at the time.

During the early and middle periods of the 20th century there were passionate debates over the "true method" for teaching this skill. The more widely practiced methods were variants of the Hamburg, Germany Muller-Walle "analytic" approach, based mainly on syllable drill and introduced to the U.S. at the turn of the century by Martha Bruhn. The later, "synthetic" technique, was introduced by Edward Bartlett Nitchie, the independent-thinking pupil of the Bruhn method's popularizer, Lillie Eginton Warren, and the father of the leagues for the hard-of-hearing. These methods were the basis of the lip reading instruction practiced by the teachers in the WW I program and continued in the three Army centers in WW II.

A newer method was introduced at the Michigan State Normal College at Ypsilanti, Michigan, which departed from the purely visual approach to lip reading. Having originated in the city of Jena, Germany it became known as the Jena Method. It argued that the most effective approach to becoming skilful in the process of understanding

speech, by hearing impaired persons, was to involve the kinesthetic sense, that is, to "feel" the movements of the talker one is watching.

This Jena method of speech reading (a term used as early as 1906 by Alexander G. Bell) was the favored approach in the Navy program (ibid p. 437), apparently by the supervisor of reeducation, Lt.(jg) Miriam D. Pauls.

at the time, owing at least partly to the bulkiness of the available models, the auditory training instruction utilized a single earphone, "in a fashion consonant with the effect they will get from their own individual aids." (ibid p. 441) The Lederer/Hardy report provides a very detailed description of the auditory training course, with the focus being "a complete reeducation of the person's hearing habits." (p. 443)



*A lip reading skit being performed by staff at the Naval Hospital in Philadelphia. The animated actor in the center is Lt.(jg) Miriam Pauls, Supervisor of Re-education of the program.*

### AUDITORY TRAINING

This activity was headed by Lt.(jg) Harriet L. Haskins. An interesting view expressed in the Lederer/Hardy report as an explanation of the need for auditory training was that "We are convinced ...that a person could not achieve the optimum use of a hearing aid without something more than a few kindly words of advice" (ibid p. 440). This view is still advocated today, if not widely honored in practice.

Because the dispensing of binaural hearing aids was not considered feasible



*Practice in using the telephone with hearing aids worn on the chest. The telephone is inverted so that the receiver faces the hearing aid's microphone. (Naval Hospital, Philadelphia)*

### SPEECH TRAINING AND CORRECTION

As in the army centers, the Navy program included a belief in the desirability of instruction in speech production for hearing-impaired persons,

even for those without evidence of related speech or voice changes, to maintain their normal speech patterns. This “speech insurance” training stressed the relationship between speech and hearing and included drills in producing good, intelligible speech as a means of avoiding the undesirable changes in speech and voice that

bone conduction audiometry the hearing tests included measurement of the threshold of hearing for speech in a two-room arrangement for loudspeaker presentation via live voice. The limit before overload of the equipment that was custom-assembled for the purpose was 80 dB, although the reference was not stated (p. 445)

were sufficiently disparate, particularly in size, that this factor could significantly influence the patient’s comparative judgment.

The final choice of a specific hearing aid was based upon the speech reception tests in the sound-treated double room.

As in the army centers, ear molds were fabricated in the center’s own hospital facilities, with the advantages of speed of availability and “fine-tuning” fit and comfort.

Comment: To appreciate the remarkable evolution of the hearing aid in the second half of the 20th century one need only read the constricted proposals, in the Lederer/Hardy 1946 report, for more “advanced” hearing aids than the bulky, two-pack models of that day. (pp.454-5) The thrust of their proposals can be gleaned from their recommendation that such a hearing aid “would include a combination battery pack, sufficiently adjustable so that it might be packaged with the transmitter [i.e. the microphone-

amplifier unit] or worn as a separate unit”. (p. 455) Will we be more prescient in foretelling the future evolution in acoustic management of hearing problems in the next half century?

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*A speech correction session at the U.S. Naval Hospital. Each patient’s speech was recorded for playback on the revolutionary recording device that used a metal magnetic tape on a reel.*

might be expected to accompany hearing loss.

Speech correction was available for those with noted speech and or voice deviations, often associated with pre-induction hearing losses. In apparent coordination with the instructors of speech reading, the speech correctionists emphasized the kinesthetics of speech, which would be cues to speech reading as well.

## AUDIOMETRY AND HEARING AID FITTINGS

These activities were headed by Lt. (jg) Eva A. Thompson, who was known to old-timers in this field as the knowledgeable associate, on hearing problems, of the famous Dr. Walter Hughson.

In addition to pure-tone air and

The Navy program received the technical data on the performance of the current hearing aids that was provided to the military clinics by the National Defense Research Committee, which was also involved in the assembling of test equipment for the speech reception testing.

The fitting of hearing aids consisted of several steps. First, the patient tried 3-4 different hearing aids under usual listening conditions, during which he might reject those judged to be annoying or to have poor quality. NOTE: My own recollection of patient reactions to specific hearing aids, at that time, and continuing for some years after the war, was that the physical appearances of the available models

# DESHON GENERAL HOSPITAL AURAL REHABILITATION CENTER

*Butler, Pennsylvania*

*The following discussion of the Deshon General Hospital is based on the annual reports of the Hospital for the years 1942-1946 (Annual Reports, 1942-1944, 1945, 1946), and also on discussions with the few survivors I could locate and communicate with, some published material, as noted, and a few reprints of such items that were supplied to me by surviving colleagues. Major Martin and I visited the Deshon unit on June 11-14, 1945 as part of our authorized travel to the Army units to compare experiences.*

## BEGINNINGS

The Deshon Hearing Services Program actually began at the Walter Reed General Hospital in Washington, D.C. with one lip reading teacher, Virginia Harbour. (The Service Club, 1944) Harbour was joined at the beginning of August 1943 by lip reading teachers Shirley Stein, Lorraine Amos, Frances Downes and Elizabeth Helm Nitchie. Sgt. Francis Sunday, the one enlisted soldier on the staff, constituted the Acoustic Section, responsible for hearing tests, hearing aid selection, etc. (Personal correspondence with Shirley Stein by telephone 16 July 2000.) Sunday later represented the non-medical sections of the Deshon Center program at the planning meeting of the heads of the three army aural rehabilitation centers at the Hoff center in February, 1944.

The Walter Reed Hospital was evidently too busy to handle the aural rehabilitation program, and it was relocated in November of 1943 to the Deshon General Hospital in Butler, Pennsylvania. Along with Sunday the personnel that moved included Stein and Nitchie, who became the head of the lip reading section. Sunday was soon followed by Private First Class Hugo Schunhoff as a lip reading teacher, then Pfc Lee Doerfler and Pfc Albert Douglas as Technicians in the Acoustic Department. (Personal correspondence with Lee Doerfler by telephone 15 August 1998)

Initially the Deshon Center Program was headed by Lt. Col. Marion R. Mobley, who was followed as Chief of Service by Edward Truex, Jr.

Raymond Carhart joined the Deshon program in mid-April 1944 as the Chief of the Acoustic Department, first on a civil service appointment, beginning on April 14, 1944. From November 27, 1944 he continued as a commissioned officer (Captain) until April 20, 1946. (Personal correspondence from Kevin B. Leonard, University Archives, Northwestern University Library, Evanston, Ill. Sept. 3, 1999)

The staff of the Deshon unit on January 1, 1944 consisted of seven lip reading teachers, 2 acoustic technicians and one medical officer. The title "acoustic technician" indicated those who tested hearing and were responsible for authorizing the issuance of hearing aids to patients. By December of that year the staff had grown to include 3 medical officers, 1 acoustic physicist (Carhart), 5 acoustic "experts", 4 acoustic "clinicians", 1 auricular therapist, 3 auricular therapy instructors, 23 lip reading teachers, 2 speech correctionists, 1 psychologist, 2 psychometrists and a clerical staff.

As noted at the other military units, despite an anticipated inflow of patients suffering from war-incurred trauma, a large percentage of the patients had brought their hearing deficits with them into service. Thus, the 1944 Deshon report indicates that 53% of their patients had histories of pre-induction hearing loss that had been recorded by the induction examiners as normal hearing.

The 1944 report emphasizes the rapid advances in the activities of the Acoustic Section, evidently related to the addition of Carhart as chief of the section in mid-April. This period saw

the installation of sound-isolated hearing test chambers, sound treated rooms and specialized electronic equipment, all after June 1, 1944.

Before that date hearing aid "fittings" were made by representatives of hearing aid companies and the selection of the one hearing aid issued was based upon the patient's report of which was found "most pleasing" after he used each trial aid around the hospital.

By July, however, the clinic staff did the "fittings", drawing on a library of makes and models as loaners, and a "listening hour" in which the patient listened with each aid to a variety of environmental sounds. Final selection was made from the 3-4 "best" aids, on the basis of sensitivity (including speech reception) tests, tests of "upper limits" and performance in noise. The selected instrument was then issued to the patient. The commercial hearing aid companies represented at the Deshon unit at the time included: Acousticon, Audiphone, Aurex, Beltone, Maico, Otation, Radioear, Sonotone, Telex, Vacolite and Zenith.

## HEARING AID SELECTION

*Detailed accounts of the Deshon program's philosophy and procedures are found in the series of articles published by Carhart in 1946-7, (Carhart, 1946 a,b,c,d: Carhart, 1947 a and b). The following is based on those publications, as well as on the other sources for this report.*

The hearing aid program at Deshon began with a thorough work-up by the Center's multidisciplinary team of medical and non-medical personnel. By the time the Center had its full staff and

*\* I am deeply grateful to Professor Sandra Gordon-Salant for devoting considerable time and effort to gathering and dispatching to me pertinent material from the U.S. National Archives at College Park, Maryland.*

specially designed and fabricated equipment the hearing examination included pure tone audiometer tests, both air and bone conduction and the newly-introduced speech perception tests, including the “phonetically balanced” (PB) word lists provided by the Harvard Psychoacoustic Laboratories.

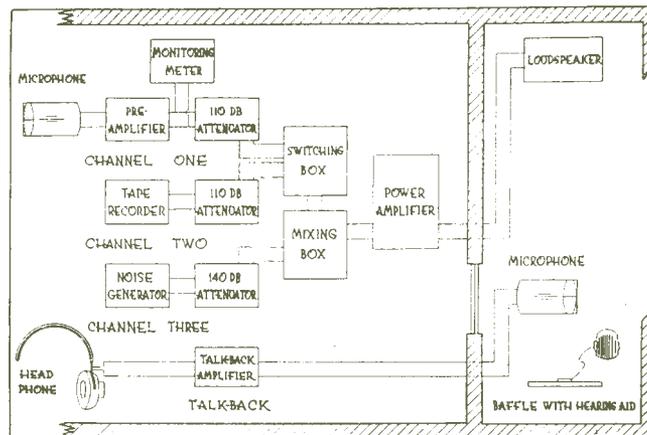
The technique for finding the pure tone thresholds, at the Deshon Center, “followed rigorously” the procedures devised by Hughson and Westlake, as contained in a manual prepared by them for the Committee on Conservation of Hearing (Hughson and Westlake, 1944).

The hearing loss for speech was determined through headphones in a two-room testing setup as at present, using “equated word lists” or if necessary, just simple questions about Army experiences, again using the Hughson-Westlake technique for obtaining the level of 50% correct responses as the threshold. (Carhart 1946b, pp3-4) (It is of interest the the term “spondee” is not mentioned in the article.)

Today’s audiologists will be surprised at Carhart’s spirited advocacy of the usefulness of the measure of hearing loss for speech, as he writes, partly in italics for emphasis, “Further, experience and experimentation have led the group at Deshon General Hospital to the firm conviction that loss in ability to hear speech is an essential datum which must be obtained with every audiometric test” (ibid p. 5). Carhart discusses the general agreement of the threshold of hearing for speech and the average loss at the pure tone frequencies 512-2048 cycles per second as noted earlier by Hughson and Thompson (1942), but argues that significant discrepancies in a particular case can have clinical importance.

The next step in the work-up preceding the evaluation with trial hearing aids included a test of speech discrimination. The test material is not clearly stated in this article (Carhart 1946b), other than the statement that “It is one devised at this hospital to give a general picture of discriminative ability and also to isolate the speech sounds causing the patient’s particular difficulty.” Interestingly, Carhart notes that such

information can indicate the need for “special training procedures ..to increase efficient use of an instrument” (ibid p. 6). In tests with trial aids, however, the “phonetically balanced” (PB) word lists



Schema for hearing aid fitting (Deshon General Hospital).

developed at the Harvard Psychoacoustic laboratory were included.

A characteristic of the Deshon testing was the use of “live voice”, in which the test material is spoken by the tester through a microphone, with monitoring of the level via an intensity meter, in contrast to the preference at the Hoff Center, for example, for the recordings prepared by the Harvard and CID laboratories. (See discussion on NDRC of this report.)

An attractive feature, at the Deshon center, was the inclusion of “listening hours”, before and after the introduction of hearing aids. Here a group of patients listened through a group hearing aid to a variety of recorded noises and sounds, such as instrumental music and speech, as a structured preparation in the rating system to be used later with the trial hearing aids.

After the fabrication in the hospital’s own laboratories of the patient’s ear insert, as in the other military centers, the patient used a pre-selection of various hearing aids and their combinations (e.g. of different receivers) for one day each. In addition to his rating the performance of each in use around the hospital and at instructional sessions in lip reading and others, he again attended the “listening hours”, where he rated the instrument he had been wearing for the past day. Carhart believed that these

experiences with the various aids constituted “preliminary auricular training” in which the patient “develops awareness of auditory differences and lays the foundation for more rigorous training” when the patient finally received his own hearing aid (ibid p. 10).

### COMPARATIVE EVALUATION OF HEARING AIDS

Following the weaning out of less acceptable hearing aids the remaining 3 or 4 hearing aids were then included in the formal comparative hearing aid evaluation, in which four tests were conducted.

As the forerunner of such testing in audiology clinics ever since, hearing aid selection in the fully organized stages of the

WW II military clinics took place with the patient seated in the sound isolated test room facing a loudspeaker, adjacent to the “control” room, where the tester operated the test equipment and watched the patient through a small window.. Carhart’s illustrative example at Deshon was similar to those at the other centers.

The hearing aid under test was placed on a baffle above and behind the seated patient, with the receiver cord running down to the receiver which was snapped



Early hearing aid evaluation

onto the fabricated ear insert in his ear.

Four measures were employed at the Deshon Aural Rehabilitation Center:  
a. Sensitivity, or effective gain  
b. Tolerance limit



c. Effective speech-to-noise ratio  
d. Discrimination. In Carhart's (1946c) article he stated that this was a measure of "the efficiency with which the patient could distinguish small sound differences" (ibid pp 780-781), but in application it was a test of word discrimination.

Before beginning the test, the patient was asked to adjust the gain control of the first hearing aid so that it would be comfortable for speech coming from the loudspeaker at 40 dB above normal threshold. (Carhart 1946c, p. 782) (Note that all levels here are in terms of dB above normal threshold. Post-war measurements with sound level meters found normal speech reception thresholds for spondee words to be about 22 dB SPL, which meant that the 40dB test level was actually about 60-62 dB SPL.)

The effective gain of the aid, set thus for the "40 dB comfort level", was taken as the difference between the unaided sensitivity, or speech reception threshold (SRT) and that obtained with the hearing aid.

Next the tolerance level, with the same gain setting, was determined by raising the signal level gradually until the patient indicated that it was no longer tolerable or 85 dB was reached.

The two tests were then repeated with the gain control set at the hearing aid's maximum.

With the input signal raised to 50 dB the signal-to-noise (S/N) ratio was determined as "the limit of efficiency of the instrument in background noise." (Carhart 1946b, p. 16), In another article Carhart suggests that the test noise might be either "a combination of thermal hiss and static pulses or sawtooth waves with a basic frequency of 120 cps". (Carhart 1946c)

After rechecking the SRT with the aid set once again for the 40 dB level the patient was tested for speech discrimination of words presented at 25 dB above that SRT. A difference of 8% or more was used in selecting the aids. It is interesting that Carhart considered the probable usefulness of what was later called the "intensity-performance" function "to ascertain the sharpness of discrimination for different input levels of speech" (ibid p. 788), but cautioned that the procedure needed the accumulation of more data.

The head of the Acoustic Clinic then conferred with the patient to select the "best" instrument, mainly but not exclusively, on the basis of the

results of the four tests. When the performance results were essentially equivalent on more than one instrument "selection was based on auxiliary factors of convenience, weight and esthetic preferences" (ibid p. 790).

### COOPERATION WITH NDRC

Along with the other army centers and the Navy Center, the Deshon unit was involved in 1944 in the hearing aid studies of Project 17.3, a contractual arrangement between the Office of Scientific Research and Development of the National Defense Research Committee and the U.S. Army and Navy. According to a bimonthly progress report of Division 17, Section 17.3 of the National Defense Research Committee, dated July 1, 1944, on the Subject: Study and Development of Instruments to Aid Militarily Incurred Deafness, the role of the Deshon Center was to validate and apply the results of studies at the Harvard University Psycho-Acoustic Laboratory and the Central Institute for the Deaf on the development of new tests and instruments for the evaluation and fitting of hearing aids.

### LIP READING

This activity was similar to those at the other military centers in which the largest staff allocation was for the teaching of lip reading, the original service with which the program had begun. At first, all lessons were individual, with one lesson each day. By April 1944 group practice sessions were added and each patient attended one individual and at least one practice class daily. These were taught by a rotating roster of teachers, to provide "different accents, inflections and pronunciations." (Annual Reports, 1942-44, p 13) There was an attempt to include moving picture films for lip reading practice, but the staff were not satisfied with the quality or content of the available films.

### SPEECH CORRECTION

About thirty per cent of the hearing impaired patients at Deshon, in 1944, were found to have "speech abnormalities", and in 8 % these were thought to have resulted directly from the hearing problem. The summary of the patient speech problems, in 1944, follows:

Dyslalia	49.6 %
Dysphonia	44.5 %
Dysphemia	4.6 %
Dysphasia	0.8 %
Dysarthria	0.6 %

### SUMMARY OF THE DESHON PROGRAM

By the end of 1945 the staff of the Deshon Center had grown to number 52, in a year that saw their peak patient load and the issuing of 1,584 hearing aids. It was also a year in which, as at the other military units, the prevalence of "functional" hearing loss or functional exaggeration of a previous hearing problem was recognized, in 8% of their patients.

The Deshon program closed at the end of April 1946 after the end of the war, having processed a total of 3, 663 patients and having issued 2,792 hearing aids.

The Deshon program was another of the military's historic examples of a multidisciplinary approach to the problem of hearing impairment among adults, with the introduction of new technology and materials and the emergence of creative thinkers, such as Carhart, who laid the basis of the new profession of audiology.

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### APPENDIX 3: DESHON GENERAL HOSPITAL HEARING PROGRAM STAFF

AS OF JULY 7, 1944:

Chief of Service

Lt. Col. Marion R. Mobley

Acting Chief of Service

Major Edward H. Truex, Jr.

Otologists

Captain Henry C. Barnaby

Captain Robert A. Schein

Acoustic Department

Raymond Carhart, (later Capt.), Chief

Pfc Lee Doerfler

Pfc Albert Douglas

Pfc Wayne Jeans

Sgt. Francis H. Sunday

Mary Schmitz

Clinical Psychologist

Donald A. Ramsdell

Speech Correction Department

Verna Ailhouse

Florence Henderson

Auricular Training Department

Laila Larsen

#### LIP READING DEPARTMENT

Elisabeth H. Nitchie, Principal

Mina Avery

Kathryn Becker

Alice M. Burtnett

Margaret Dunn

Mae T. Fisher

Agnes Frazier

Emily Harris

Mary G. Hearty

Emma D. Kessler

Helen S. Lowry

Mary MacCracken

Cpl Helen Meyer

Kate Morphy

Florence Murrin

Josephine Prall

Gertrude Russell

Pfc Hugo Schunhoff

Shirley P. Stein

Virginia Terry

Margaret Thompson

Gertrude Torrey

Mary K. Van Wyk

Esther Vonderheit

Florence Wooley

#### RED CROSS

Sarah Bomberg

Joan Bonner

Rhoda Kapelman

Phyllis McCalmont

Minala Seibel

## Conclusion

The “aural rehabilitation” programs that were set up in the American armed services in World Wars I and II can be seen as the true beginnings of “clinical audiology,” and in fact the inspiration of the new term “audiology” itself.

The basic concept was to bring to bear on its hearing casualties a multidisciplinary array of personnel and services and the latest technical equipment for measurements, testing and management, all facilitated by the unique circumstances of the liberal wartime allocation of resources.

The units that were set up in 1943 in the U.S. Army and in 1944 in the Navy brought together a concentration of military and civilian medical, rehabilitation, psychological, social work and technical personnel, who focused their specialized knowledge and skills on young adults who suffered from mild to profound loss of hearing. A significant contribution to the maturation of the new professional field was the development, calibrations, and validation of sophisticated hearing test equipment and stimuli by the Harvard University Cruft and Psycho-Acoustic laboratories and the Central Institute for the Deaf, under the aegis of the National Defense Research Committee (NDRC) of the Office of Scientific Research and Development.

Whereas the WW I unit lasted just one year and serviced only 108 soldiers of the nearly 13,000 who later claimed hearing losses through the Veterans Administration, the WW II centers

processed about 14,000 between late 1943 and 1946.

The beginnings of the WW II programs were based essentially on a continuation of the WW I reliance on the teaching of lip reading, but as the staffs grew to include university trained speech scientists like Grant Fairbanks of the University of Iowa and Raymond Carhart of Northwestern University and others who were graduates in speech correction and teaching of the deaf, along with the technical input sponsored by the NDRC, the focus changed quickly to exploit the scientific and technical orientation of this personnel infusion.

The relatively crude but effective new electronic hearing aids that resulted from the competitive interest of the manufacturers in this attractive new market encouraged these staff members to exploit the emerging technology as fully as possible in the management of hearing impairment.

There was a price to pay. As the availability of new technology piqued the curiosity and desire for more “science” in our new profession, the concentration, before and during the military programs, on a total approach to restoring effective communication ability and concern for the psychological, social and vocational needs of each hearing impaired adult would soon become diminished in the emerging “audiology.”

Fortunately for the patients of the WW II programs, the transition actually provided them with the best of the the

two eras. The organization of the rehabilitation programs at all four centers contained the full rehabilitation focus while eagerly introducing the new technology.

The new interest in the validation of procedures, such as the testing of hearing, undoubtedly helped to end such misleading practices as the uncontrolled whisper and speech tests which were mandated in the induction and assignment of military personnel.

But above all the opportunities to develop new knowledge and skills that were provided by the well funded and generously staffed military programs led logically to the fashioning of a new service profession. As they returned from the war to civilian life a number of those who had developed new insights while members of the staffs of these units became leaders in the establishment of training programs in the nation’s universities and in the staffing of such units as the Veterans Administration. Their efforts following WW II and those of the colleagues and students with whom they interacted produced new professional workers for the field, generated expanding research, engaged in a flow of related scientific and professional literature, and promoted the activation of national and international scientific and professional meetings and public information activities that have brought about the universal recognition of audiology and clinical audiology.



*Military audiology facilities provided early research in hearing evaluation methods and procedures.*



*Post-war diagnostic audiology "narcosynthesis" evaluation.*



*Special attention was given to aural-speech training.*

*Post-war hearing evaluations often required Galvanic skin response conditioning with mild shock reinforcement to confirm hearing thresholds.*



*An early wartime aural rehabilitation class.*

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