BOOK REPORT SECTION

This department currently provides descriptions of the contents and availability of published material, including conference proceedings and other publications which, while they may not enjoy wide distribution, may constitute a valuable contribution to the literature of a specific area of rehabilitation.

It is hoped that it will also be possible to publish informed reviews in depth of significant additions to the literature. Readers interested in contributing such reviews are encouraged to do so.

THE VANDERBILT HEARING-AID REPORT.

Gerald A Studebaker and **Fred H. Bess,** Eds. Copyright 1982, Monographs in Contemporary Audiology, 6796 Market St., Upper Darby, Pennsylvania 19082. Printed, soft cover, 223 pages: available at $24.95 plus $2 postage and handling from Contemporary Audiology. (Tel. (215) 528-5222.)

Selected material from The Vanderbilt Hearing-Aid Report is reprinted here for review and general information purposes with permission of the copyright owner.

The Vanderbilt Report (sub-titled State of the Art—Research Needs) reports the proceedings of "A Working Conference on Amplification for the Hearing Impaired: Research Needs" held at the Bill Wilkerson Hearing and Speech Center of Vanderbilt University in Nashville, Tennessee, on June 7 through 10, 1981.

The Editors have expressed appreciation for the sponsorship of the conference by the Veterans Administration's Rehabilitative Engineering Research and Development Service (since re-named Rehabilitation R&D), and to the publishers of the Monographs, especially E. R. "Cy" Libby.

The Journal of Rehabilitation Research and Development, with permission, is reprinting immediately below the final paper in The Vanderbilt Report, "Review and Implications for Research," by Wayne O. Olsen, Ph. D., Rochester, Minnesota. Dr. Olsen begins by briefly reviewing major points in the 30 other papers presented during the Working Conference. His paper is followed by a listing of papers and authors from the conference.

"Review and Implications for Research"

By Wayne O. Olsen, Ph. D.
Rochester, Minnesota

ABSTRACT

This paper briefly reviews major points in the previous papers. In addition, detailed psychoacoustic studies of individuals having normal hearing via one ear, but some degree of hearing impairment for the other ear are advocated. Successful hearing aid users should also be studied in an effort to determine the bases for their successful use of their hearing aid(s).

KEY WORDS: Hearing Aid Research

At this point, I think it most appropriate that we thank the Veterans Administration, specifically William Manley, Henry Speuhler, Margaret Giannini for sponsoring this conference. In my opinion, its been most informative and stimulating.

I think all of us should also thank Fred Bess and his staff here at Bill Wilkerson Hearing and Speech Center and Vanderbilt University for serving as hospitable hosts and making our stay pleasant.

Thanks also are due to Fred Bess and Jerry Studebaker for their efforts in organizing this conference. Some of us served on a steering committee and provided a little guidance in the early stages of the planning of this conference, and occasionally as the planning progressed, but it was Bess and Studebaker who really did the major work in arranging this meeting.

For a variety of reasons, I hope to focus on what I consider to be "positives" of the preceding papers. One reason is that I do not claim to have a better mousetrap than anyone else here. Another reason is that I do not think I have a particular ax to grind. At least I hope not. Hopefully, from these points of view, I can summarize, and sometimes comment, on these proceedings in a relatively objective manner.

The task I set for myself was to try to pick out what were, for me, one or two golden nuggets from each of the presentations. Of course, a comment, an idea, or a bit of information which I consider to be a golden nugget, some of you may consider to be a lead dud. That's fine. I did not agree with everything that has been presented here either. However, I choose not to concentrate on those items from this particular forum.

One of the statements made by Beck was that there is a need to develop and refine measurement procedures for special features available in hearing aids, e.g. compression, high frequency emphasis, directional microphones, etc., both in terms of electroacoustic and psychoacoustic measurements. In this light it is worth noting that Scharf commented upon psychoacoustic procedures and data dealing with just these facets in terms of loudness, intensity and frequency discrimination, frequency selectivity and localization for normal hearing and hearing impaired subjects. These are the very areas in which there have been relatively recent developments in hearing aids in terms of directional microphones, compression amplification, high frequency emphasis amplification, modification of frequency responses, etc. Now if we could only assess psychoacoustically how various hearing aid characteristics interacted with parameters of loudness, frequency selectivity, etc. for hearing impaired subjects.

Humes properly reminded us of the importance of comparing test results for normal hearing and hearing impaired listeners at equal physical levels rather than at equal sensation levels. He also noted that under conditions of masking, the performance of normal hearing subjects resembled very closely the performance of hearing impaired subjects for many psychoacoustic tasks. Humes also cautioned us about the variability in the performance across human subjects for many of these tasks. Variability in performance on auditory

tasks is a human characteristic which cannot be ignored.

At this point, I would like to suggest publicly, as I have in private conversations with some of you here, that it seems to me that it would be interesting and worthwhile to include individuals having unilateral hearing losses in a variety of psychoacoustic tasks utilizing complex stimuli. At least then the subject could serve as her or his own control. Such subjects might not only demonstrate differences in loudness, frequency selectivity, temporal perception, etc. at the two ears, and thereby define how a given complex stimulus was perceived differently at the two ears, but they might also allow the experimenter to modify a complex stimulus presented to the impaired ear until it could be described by the listener as resembling more closely the manner in which the stimulus was experienced via the normal ear. The converse would also be of interest, that is, attempting to modify temporal and spectral characteristics of the complex stimulus delivered to the normal ear until it resembled the stimulus presented to the impaired ear of the listener. Might not such efforts help lead to a so-called transparent hearing aid, a term suggested by Knowles[1] in 1968? The intent is not transparent cosmetically, but transparent acoustically.

Levitt, in his usual clear fashion, described for us that important information is contained in the speech spectra and in the distinctive features of speech to which the auditory system is especially attuned. He carefully pointed out that if only the spectra of the speech were important, then it should be possible to predict speech discrimination performance with the aid of the articulation index. With knowledge of the spectra of different speech sounds and of the spectra available to a listener, it should also be possible to predict errors for a given listener and listening conditions. While such predictions are accurate to some extent for some hearing impaired subjects, the predictions are not perfect nor consistent for all subjects. Therefore, other features of speech contribute to intelligibility and at the moment we are not sure which distinctive features of various speech sounds are crucial for correct perception. Along this line though I think it is encouraging to remind ourselves that application of the concepts of the articulation index to, for example, the data of Anianson[2] and by Dugal et al.[3] to data obtained by Skinner resulted in "reasonably good agreement" between predicted and observed scores.

Significantly along this same line, Dirks presented data demonstrating application of the articulation index to data obtained from hearing impaired subjects responding to the nonsense syllable test described by Resnick et al.[4] Predictions were consistent with relative performance for the flat hearing loss group. Predictions were not as precise for the steeply sloping hearing loss group for all conditions, but the predictions generally reflected the relative performance of the group for most conditions. Such information is, in my opinion, certainly encouraging and worthy of further study and application.

At this point, Nabelek appropriately reminded us of susceptibility of speech intelligibility to degradation not only from noise, but also from reverberation. The test results she presented and her figures showing the differences in speech spectra in non-reverberant and reverberant conditions are vivid demonstrations of the effects of reverberation on the speech signal. Clearly temporal and spectral characteristics of speech are altered by reverberation.

Gelfand properly highlighted important points in Nabalek's presentation and presented valuable additional data relating to interaction of age, hearing loss and susceptibility to noise and reverberation. Clearly, as pointed out by Nabalek and by Gelfand, the interactions of the variables in speech spectra, noise spectra, reverberation, hearing loss, age, and their individual and combined influences on speech intelligibility are almost infinitely complex.

Burnett, Corliss and Nedzelnitsky reviewed basic differences in the conditions in which the electroacoustic performance characteristics of a hearing aid are determined, that is with sinusoids in anechoic chamber and the noisy reverberant room in which it is used by the listener. Importantly, however, they also pointed out the possibility of applying computer techniques to employ complex acoustic inputs for hearing aid measurements in assessing coherence and cross correlation between the input and output of the hearing aid.

Preves reviewed standards documents dealing with manikins and in-situ measurements. Certainly, the conditions for such measurements are carefully specified. He correctly pointed out that earmolds rarely are sealed in the ear of the listener as well as in the manikin. Also the relationships between impedance measurements and functional gain which Preves reported are, I think, of considerable interest.

Cox introduced the term "real ear goals" in her discussion of preferred listening levels, loudness discomfort levels, and other factors related to hearing aid use. Important concerns raised by Cox were the necessity to account for the large individual differences in preferred listening levels and loudness discomfort levels. Among those variables mentioned were personality, loudness growth function, listening demands, age, experience with hearing aids, hearing aid characteristics, etc. Here again are enumerated a large number of variables which may influence the hearing impaired individuals in the selection, setting, and use of a hearing aid.

McCandless adopted Cox's term "real ear goals" in discussing relationships between electroacoustic characteristics of hearing aids and functional correlates relative to the experiences of hearing impaired individuals with these devices. The important question is, how large or small a difference in some measured electroacoustic characteristic makes a difference to the hearing impaired subject?

Lybarger reviewed previous devices for telephone coupling, and acoustic to magnetic converters available from AT&T and Bell Canada. Resolution of current problems in direct acoustic coupling of telephone to hearing aid is needed. Lybarger also reviewed data of receiver outputs in 2 cc couplers and signal levels radiated back to hearing aid microphones via vents of different sizes and open earmolds. Important inferences about possible useable hearing aid gain under vented and open earmold conditions were presented. Peaks in the frequency response responsible for feedback in most hearing aids occur between 1700 and 2500 Hz.

Egolf quickly reviewed 6 techniques and corresponding engineering mathematical equations to explain and help reduce feedback (or "howlback" as he labelled it) problems in public address systems. Definitions are available but their direct application to hearing aids for satisfactory signal pro-

cessing probably are not immediately imminent.

Killion demonstrated the marked influence of earmolds on frequency response curves of hearing aids. He also made a plea for consideration of quality judgments in listening evaluations of hearing aids. Feedback control via damping filters in the hearing aid hook or tubing and by changing the form of the earmold vent were also suggested by Killion.

Libby nicely reviewed for us that in general terms earmold modification of venting affects the frequencies below 1000 Hz, filters damp frequencies between 1000 and 3000 Hz (right in frequency region of feedback problems noted by Lybarger) and horn effects such as seen in the 8CR earmold enhance hearing aid output for frequencies above 3000 Hz. One gained the impression that his experience with 8CR earmolds has been quite favorable.

Lim's discussion of signal processing, i.e., speech enhancement techniques, reviewed methods of filtering, fast Fourier transform and power specta subtraction, etc. for speech enhancement in noise. Different techniques for most effective signal processing for reductions of distortion of speech sounds due to reverberation requires 2 microphones at different locations. He commented that to date, most evaluations of signal processing for speech enhancement had resulted in judgments of improved sound quality but the intelligibility of the speech did not seem to have been improved. Even though speech intelligibility was not improved, we probably would do well to keep in mind that LeBel[5] suggested in 1945 that listener fatigue probably is less rapid if the perceived sound quality is improved.

Schaeffer emphasized that auditory handicaps can be lessened by improving the speech to noise ratio. Adaptive systems which are adaptable to the environment and adaptable to the hearing impairment are needed. Importantly, very large scale integrated circuits (VLSI) probably can handle the fast Fourier transform used in some attempts for speech enhancement.

Braida suggested that one approach would be to study hearing aids that do work and contrast them to hearing aids that do not work. He suggested that with compression amplification the intent is to squeeze speech into a limited dynamic range and cautioned that according to recent measurements in their laboratory at MIT the dynamic range of speech sounds in a 1/3 octave band around 2000 Hz was 45 dB rather than 30 dB as generally accepted. Interesting data were reviewed in which normal hearing subjects were masked to simulate audiograms of hearing impaired subjects. Patterns of response in terms of scores and types of errors were similar for the hearing impaired subjects having sloping hearing losses and the masked normal listeners. However, the pattern of scores and errors of normal hearers masked and compared to response patterns for subjects having flat hearing losses were not similar.

Villchur noted that as early as 1937 Steinberg and Gardner[6] suggested compression deamplification to deal with recruitment. Interestingly, only 6 different researchers have since agreed that processing speech via frequency response shaping or via amplitude compression did improve speech intelligibility. He also suggested that speech test materials used in evaluating amplification systems have a smaller dynamic range than speech heard in environments other than the test environment. Directions which seem worth pursuing are systems providing multichannel compression plus frequency equalization.

Studebaker reviewed various strategies utilized in hearing aid selections and hearing aid evaluations. Importantly, he differentiated between the possibilities for tests and time available in laboratory settings and tests and time available in clinic settings. Within limitations, laboratories allow for more time consuming tests, evaluations and manipulations of a number of variables not possible in clinical settings which are necessarily more time conscious. While Studebaker suggested that judgments of the quality of sound heard through hearing aids are a powerful force in the use of hearing aids and should be researched fully, he also discussed experimental results obtained using both quality judgments and speech discrimination tests.

Skinner et al described a system of selecting hearing aids based on functional gain measurements, most comfortable listening levels, loudness discomfort levels, coupler measurements, and estimates of speech spectra to fit the amplified speech spectra into the dynamic range of the hearing impaired individual. With the aid of a computer program to determine the desired characteristics of hearing aid gain, frequency response, and saturation sound pressure levels, a commercially available aid is adjusted and compromises are made on the basis of clinical judgments and what is feasible with available instruments. This process can be completed in about one hour. Importantly, with their procedure the patient can be shown graphically what the clinician has attempted to accomplish to improve his or her ability to hear speech in the counseling session which follows the testing.

McCandless' discussion of in-the-ear acoustic measurements focused not only on the repeatability of the measurements but also those variables which affect the measurements. He stressed that research must be completed to relate in the ear probe microphone measurements to other measurements of the hearing aid and successful use criteria. He also reviewed interesting data relating relationships between functional gain measurements, probe microphones measurements in the ear canal, and measurements with KEMAR.

Byrne indicated that he preferred to call the approach he has described a theoretical approach because it postulates that specific amplification characteristics are most appropriate for persons having certain measurable characteristics. As in other procedures such as described by Skinner et al, the intent is to deliver as much of the speech signal as possible into the useable auditory range of the hearing impaired individual. Byrne stressed that hearing aid selection procedures must have a carefully considered rationale that should be a quantitative expression of certain relationships rather than a magical set of numbers. It is these relationships that must be studied and validated in improving hearing aid selection procedures.

Schwartz focused our attention on the five premises underlying the purpose of hearing aid selection procedures. He properly pointed out that of the variety of procedures currently in use, none have met the five assumptions. Little or no data are available demonstrating the validity of the various procedures. Efforts must be directed to validating tests in use and tests being developed or under consideration for development in terms of each of these five premises as well

as validating the rationale and necessity of hearing aid selection procedures.

At this point, Walden appropriately reviewed attempts of others and attempts of his group to validate certain hearing aid selection procedures by assessing acceptance, modifications made, and satisfaction with hearing aids by hearing impaired individuals. Various hearing aid selection and validation procedures with their many variables and different sets of problems were reviewed. Although an obvious aim is to optimize acceptance and use of the hearing aid, a key question becomes, how do we or the hearing impaired individual really know what should be considered as optimum?

Owens agreed with Walden that the validating process of hearing aid selection is a most neglected area. He also reviewed the recently developed Hearing Performance Inventory. For this questionnaire, the hearing impaired individual rates difficulties encountered in 90 or so different listening situations. The Hearing Performance Inventory attempts to measure how a person hears and how that individual adjusts to the hearing loss. Although there are no questions dealing specifically with hearing aid use, comparison of self judgments of hearing abilities without and with a hearing aid should prove informative in terms of success or lack of success in hearing aid use as well as provide information important for counseling the hearing impaired individual.

The importance of follow up and counseling in assisting the hearing impaired individual in the use of hearing aids was also stressed by Brooks. He suggested that, in fact, the counseling should begin before fitting the hearing aid. As he pointed out, the decision to use or not use the hearing aid is one made by the patient. The important point is that the patient should be well informed about the hearing loss, hearing aid use and appropriate levels of expectations. Hearing aid acceptance and use has been demonstrated to be considerably better for those patients who have been counseled, guided and instructed in hearing aid use than for those who have received a minimum of assistance in adapting to hearing aid use.

Along these same lines, Osberger and Collins suggested that counseling of the hearing impaired subject should begin prior to fitting the hearing aid. She stressed that attitudes of acceptance of the problem and the use of a hearing aid must be forged prior to the hearing aid evaluation and use. Importantly, she noted that of the factors to be evaluated in the hearing aid selection and rehabilitation process, the effectiveness of counseling techniques should also be studied.

Ross reminded us that hearing impaired individuals repeatedly report to us that they are unable to appreciate and enjoy with their families and friends any activities in which the speech of interest is generated at some distance from the listener, e.g., theatre, movies, lectures, public meetings, worship services, etc. He introduced the term "communication access" and informed us that among other provisions of the Federal Rehabilitation Act of 1973, Section 504 specifies communication access in the form of listening systems to assist hearing impaired individuals must be available in meeting rooms of federal buildings. He enumerated the attempts of a number of theaters, etc. to provide group amplification systems for hearing impaired individuals and recounted his personal experiences and delight in the use of such systems in a theater.

Konkle noted problems encountered by hearing impaired youngsters as well as others in noisy reverberant classrooms and the like. He endorsed the remarks of Ross as serving to focus on the needs to expand deliberations and efforts to evaluate and improve amplification systems other than wearable personal hearing aids.

Each of the papers suggest directions for continued research but at this point, I would like to pursue for a moment, another avenue of research which has been alluded to, but not stated directly, at least to my interpretation of the discussions here. It seems to me that it would be worthwhile to direct efforts toward determining the markers of hearing aid performance characteristics, psychoacoustic performance on various discriminatory tasks, the personal characteristics, etc. of the "successful" hearing aid users, i.e., those individuals who consider themselves and are considered by their families and collegues to be using hearing aids successfully. Given that information, maybe we might learn some of the converse characteristics that are detrimental to successful hearing aid use. Maybe then we could begin to devise some means and methods for modifying certain amplification and signal processing characteristics, attitudinal sets, or whatever, to try to help those individuals who are not successful hearing aid users and therefore do not use their hearing aids at all or only on a very limited basis, to become successful hearing aid users, or at least more successful than they were previously.

Given the myriad of variables and interactions discussed by the participants of this meeting, the task for beginning to study and resolve specific facets of the problems of amplification for hearing impaired individuals certainly seems formidable to say the least. The fact that there are individuals here willing to accept the challenge to attempt to provide data and information for improving devices designed for such purposes, and for providing services to hearing impaired persons is, however, most encouraging. Progress has been made. More progress will be made as workers in different disciplines have the opportunity to meet and work together toward common goals.

A meeting such as this also represents a challenge as well as encouragement to agencies in a position to support research efforts directed at developing information from which benefit can be derived by hearing impaired individuals. Now and for the future we thank Veterans Administration, Fred Bess and the Bill Wilkerson Hearing and Speech Center of Vanderbilt University, and others here for making that possible.

REFERENCES

1. Knowles, H. Some consideration for hearing aid frequency response curves. Paper presented at American Speech and Hearing Association Convention, Denver, 1968.
2. Aniansson, G. Methods for assessing high frequency hearing loss in everyday listening situations. Acta Oto-Laryngologica Supplement 320, 1974.
3. Dugal, RL, Braida, LD & Durlach, NI. Implications of previous research for the selection of frequency-gain characteristics. In, Acoustical Factors Affecting Hearing Aid Performance, edited by G. Studebaker and I. Hochberg, University

Park Press, Baltimore, 1980.
4. Resnick, SB, Dubno, JR, Hoffnung, S & Levitt, H. Phoneme errors on a nonsense syllable test. J Acoust Soc Amer 1975(A); 58 S1:115.
5. Le Bel, CJ. Hearing aid technic. Electronic Industries. 1945; 4:104-106 and 198-204.
6. Steinberg, JC & Gardner, MB. The dependence of hearing impairment on sound intensity. J Acoust Soc Amer 1937; 56:1601-1611.

"CONTENTS" listing of the Vanderbilt Hearing-Aid Report follows.

1. Basic Research—Sound Perception by the Hearing Impaired

Psychoacoustics of Elementary Sounds: B. Scharf, Ph. D., and M. Florentine, Ph. D. pp. 3—15. **Spectral and Temporal Resolution by the Hearing Impaired:** L. E. Humes, Ph. D. pp. 16—31. **Speech Discrimination Ability in the Hearing Impaired**: Spectrum Considerations: H. Levitt, Ph. D. pp. 32—43. **Comments Regarding "Speech Discrimination Ability in the Hearing Impaired:"** D. D. Dirks, Ph. D. pp. 44—50. **Temporal Distortions and Noise Considerations**: A. K. Gelfand, Ph. D. pp. 51—59. **Comments on "Temporal Distortions and Noise Considerations:"** S. A. Gelfand, Ph. D. pp. 60—64.

2. Basic Research—Electroacoustic Considerations for Hearing-Aid Performance

Research Problems in Coupler and In Situ Measurements on Hearing Aids: E. D. Burnett, B. A., E. L. R. Corliss, M.S., and V. Nedzelnitsky, Sc. D. pp. 67–73. **Coupler and In Situ Measurements**: D. A. Preves, M.S.E.E. pp. 74–77 **Functional Correlates of Electroacoustic Performance Data**: R. M. Cox, Ph. D. pp. 78–84.

3. Engineering Applications: Special Problems

Acoustic Feedback Control: S. F. Lybarger, B. S. pp. 87–89. **Telephone Coupling**: S. F. Lybarger, B. S. pp. 91–93. **Review of the Acoustic Feedback Literature from a Control Systems Point of View**: D. P. Egolf, Ph. D. pp. 94–103. **Transducers, Earmolds, and Sound Quality Considerations**: M. C. Killion, Ph. D. pp. 104–111. **In Search of Transparent Insertion Gain Hearing Aid Responses**: E. R. Libby. pp. 112–123. **Signal Processing for Speech Enhancement**: J. S. Lim, Sc. D. pp. 124–129. **Speech Processing for the Hearing Impaired**: R. W. Schafer, Ph. D. pp. 130–132. **Review of Recent Research on Multilband Amplitude Compression for the Hearing Impaired**: L. D. Braida, Ph. D., N. I. Durlach, M. A., S. V. DeGennaro, M. S., P. M. Peterson, M. S., and D. K. Bustamante, M. S. pp. 133–140. **The Evaluation of Amplitude-Compression Processing for Hearing Aids**: E. Villchur, M.S. pp. 141-143.

4. Delivery of Services

Hearing Aid Selection: An Overview: G. A. Studebaker, Ph. D. pp. 147–155. **The Veterans Administration Hearing Aid Program: Research Needs in Amplification**: L. B. Beck, Ph. D. pp. 156–160. **Measurements to Determine the Optimal Placement of Speech Energy within the Listener's Auditory Area: A Basis for Selecting Amplification Characteristics**: M. W. Skinner, Ph. D., D. P. Pascoe, Ph. D., J. D. Miller, Ph. D., and G. R. Popelka, Ph. D. pp. 161–169. **In the-Ear-Canal Acoustic Measurements**: G. A. McCandless, Ph. D. pp. 170–174. **Theoretical Approaches for Hearing Aid Selection**: D. Byrne, B. A. (Honors). pp. 175–179. **Hearing Aid Selection Methods: An Enigma**: D. M. Schwartz, Ph. D. pp. 180–187. **Validating Measures for Hearing Aid Success**: B. E. Walden, Ph. D. pp. 188–192. **Discussion on "Validating Measures for Hearing Aid Success:"** E. Owens, Ph. D. pp. 193–194. **Pre- and Post-Hearing-Aid-Provision Management**: D. N. Brooks, Ph. D. pp. 195–198. **Factors Affecting Hearing Aids Use**: M. J. Osberger, Ph. D., and M. J. Collins Ph. D. pp. 199–202. **Communication Access**: M. Ross., Ph. D. pp. 203–208. **Research Needs in Amplification for the Hearing Impaired: A Discussion of Special Populations and Special Needs**: D. F. Konkle, Ph. D. pp. 209–213.

5. Research Needs

Review of Polled Research Priorities: F. H. Bess, Ph. D. pp. 217–218. **Review and Implications for Research**: W. O. Olsen, Ph. D. pp. 219–223.

WHEELCHAIR III—Report of a Workshop on Specially Adapted Wheelchairs and Sports Wheelchairs. The conference was sponsored by the Veterans Administration Rehabilitation Research and Development Service, Margaret J. Giannini, M.D., Director. The program was administered by Frank Golbranson, M.D., and Roy Wirta, of the Veterans Administration Medical Center at San Diego. The proceedings were published in September 1982, by the Rehabilitation Engineering Society of North America (RESNA), Donald R. McNeal, Ph. D., President.

Wheelchair III, in soft cover, 67 pages, is available at $10 ($7.50 to RESNA members) from the Rehabilitation Engineering Society of North America, 4405 East-West Highway, Bethesda, Maryland 20814. Tel. (301) 657-4142.

The background and purposes of the Wheelchair III Workshop, were well stated in the proceedings: here is a portion of the Introduction—

> Substantial guidance and direction to the development of improved wheelchair systems has resulted from three previous workshops. Wheelchair I, which convened in December 1977, dealt with manual chairs. Wheelchair II, which convened in December 1978, was concerned primarily with electrically powered systems. The third workshop, which convened in July 1981, was concerned with the coordination required to effect transition of ideas through research, development, manufacture, and application.
>
> General assessment of current wheelchair state of the art revealed the following:
>
> 1. Manual chairs: Sports wheelchair technology has figuratively exploded in the last 2 years. However, methods for the orderly transfer of technology to serve the bulk of wheelchair users has not been realized.
> 2. Powered chairs: Existing technology falls short of the performance characteristics demanded by the addition of accessories such as batteries, chair controls, proper seating, respirators, and environment controls needed to serve the severely disabled.

An overall objective was to document the findings and recommendations resulting from the deliberations that would serve as a guide for future action by sponsoring agencies, advocates, manufacturers, developers, and researchers.

The purpose of the two parallel working groups was to focus on structural and associated component requirements for improving reliability and performance of wheelchairs serving the severely disabled and the sports enthusiast, and to focus on mechanisms for evaluating the effectiveness of improvements on wheelchair performance. Inasmuch as wheelchair seating and controls were addressed in previous wheelchair conferences, focus of attention was not directed to these areas in this workshop.

On the first day of the workshop formal presentations of recent developments were made. On the second day, each section first met as an assembly to define the technical thrust and to develop its agenda, then broke into work groups to deliberate agenda items. Finally, group leaders and recorders from the work groups convened to amalgamate results. On the third day the results were presented at a plenary session with the floor open to discussion and comments. The summaries (section 4) are the result of the workshop deliberations as amended by the discussion and comment from the plenary session.

A followup meeting convened in Washington, D.C., on May 12, 1982 to review the findings and recommendations resulting from Wheelchair Workshop III. The recommendations, as set forth in this report, will be used by the Veterans Administration to develop a plan of action for implementation.

In concluding his Summary of the power wheelchair presentations and deliberations (Wheelchairs for the Severely Disabled), Chairman C. Gerald Warren made the following points—

> The status of technology that impacts upon the development of the powered chassis falls into two categories. The first is a near-term initiation of the development based on established or yet to be established criteria, and the second is longer term research efforts to address aspects for which adequate criteria do not exist or adequate component performances have not been identified. The consensus was that pursuit of the powered chassis development should not be contingent on completion of the entire research program outlined, but that some areas could be integrated with the development process. The rationale for this is that pursuit of development with even a portion of the research done would markedly increment the functional capability of the equipment needed by severely disabled persons.
>
> The issue of funding was touched upon briefly because it is a necessary element in the implementation process. Viewed as beneficial was the suggestion to seek support from a number of cooperative agencies having interest in the improvement of quality of life for the severely disabled. Several mechanisms for effecting this pooling of resources exist, one being through the Interagency Committee, constituents of which include the Veterans Administration and the National Institute for Handicapped Research.
>
> In summary, a plan for implementation emerged from the discussion. The recommended plan is that in cooperation with federal agencies and industry, a powered chassis with the characteristics described in the technical section of the report should be developed. Because of the multifaceted nature of the project, a system approach should be used wherein a grantee or contractee is responsible for developing the specifications with the cooperation of consumers, researchers, and manufacturers, overseeing the development of components and assembly, and testing and evaluating the end product. The grantee or contractee should be cognizant of the need for a short-term solution using available technology and the long-term solution where new technology may be necessary.

While much of "Wheelchair III" deals with aspects of technology and its clinical application to the improvement of wheelchair user lifestyle and independence, discussions and deliberations ranged widely. It was apparent that interest is strong in such areas as building strategies needed to surmount the political, financial, and institutional/cultural barriers which thwart the engineers' efforts to put technology fully at the service of the disabled. This passage from Colin McLaurin's Summary for the Sports Wheelchair sessions of Wheelchair Workshop III is suggestive of the complexity encountered in this area—

> Several trends were noted among research agencies, universities, and industries that tend to impede the orderly transfer of technology. Research agencies and universities often are more interested in scientific method than in solving practical problems. Government-funded research centers sometimes respond to a manufacturer's request for solving problems but only if funding is approved by the agency. Obtaining funding can be a very time-consuming process. Industry is more likely to interact with research centers in matters of science than in matters of technology, presumably to guard proprietary information. Government-funded research is public information and industry is loathe to share trade secrets. For the same reason, industries are cool to testing because of public disclosure, and for that reason would prefer to perform testing on their own. During the discussions only one firm was found to be ready to make a commitment in developing new products jointly with research centers. The express hope for the side of the user is that research and industry could work cooperatively to accelerate the process of reduction to practice.

"CONTENTS" listing of the Wheelchair III Workshop proceedings follows.

Foreword: Frank L. Golbranson and Roy W. Wirta.
Recommendations: pp. 1–2.
Introduction

Section 1: Wheelchairs for the Severely Disabled. Chairman: *C. Gerald Warren.*

Current Aspects of Delivering Powered Wheelchairs: C. Gerald Warren, M.P.A. and Marvin Soderquist. pp. 7–10.
Dynamic Factors of Powered Wheelchair Performance: James R. O'Reagan, M.S., and James J. Kauzlarich, Ph. D. pp. 11–13.
Advanced Wheelchair Design: Thomas E. Stephenson. p. 14.
Smart Wheelchair:David L. Jaffe. pp. 15–16.
Omnidirectional Wheelchair: David L. Jaffe. pp. 17–18.

Section 2: Sports Wheelchairs. Chairman: Colin McLaurin.

Wheelchair Design Efforts at the University of Virginia: Ted Bruning III. p. 21.
Ergonomics of Wheelchair Propulsion: Clifford E. Brubaker, Ph. D., and Colin McLaurin, Sc. D. pp. 22–41.
Advantages of Solid-Frame Wheelchairs: Lewis Blair. pp. 42–43.
Para-Bike: Development of an Arm-Powered Bicycle: Douglas F. Schwandt. pp. 44–46.

Section 3: Joint Session: Chairman, C. Gerald Warren.

Composite Material Applications to the Biomedical Field: Robert M. Baucom. pp. 49–50.
Scandinavian Experience: Per Finden. p. 51.

Section 4: Summaries

Wheelchairs for the Severly Disabled: C. Gerald Warren. pp. 55–58.
Sports Wheelchairs: Colin McLaurin. pp. 59–64.
Report from the National Aeronautics and Space Administration: Doris Rouse. p. 64.

Appendix 1: List of Attendees (59 persons)

NOTES & NEWS

KNUD JANSEN

Knud Jansen died August 1, 1982, after a long and painful illness, with the added burden of the death of his lifelong partner, *Ilse, some months before. Despite that, he re*mained active and working to the end. With his passing, orthopedic surgery, technical orthopedics, and rehabilitation have lost one of the foremost practitioners of this century.

Since his first appointment in 1948 as chairman of the Board of Junior Doctors in Denmark, he has had a profound influence on the practice of orthopedic surgery. In his own country he has been Chairman of the Danish Orthopaedic Association and the Danish Society of Orthopaedic Surgery; in Scandinavia, Secretary General of the Scandinavian Orthopaedic Association and, since 1968, Editor of one of the most prestigious international journals, Acta Orthopaedica Scandinavica. He was vice-president of SICOT (International Society of Orthopedic Surgery and Traumatology) from 1969 to 1972, and Congress president of SICOT in relation to the Copenhagen meeting in 1975. He was president of the society he founded, the International Society for Prosthetics and Orthotics (ISPO) from 1970 to 1977, and president of the newly-formed Trauma Foundation in 1975. His influence internationally has continued as vice-president of World Orthopaedic Concern.

His contributions to orthopedic science were recognized in his appointment as honorary Doctor of Science in the University of Strathclyde in 1980. He continued to subscribe to the literature of orthopedics covering widely-varying subjects (deep venous thrombosis, poliomyelitis, arthrodesis, amputation, congenital defects, and many others) and has lectured in virtually all the main orthopedic centers in the world during his career.

Even this list of achievements cannot tell the whole story of his enormous influence through his students and colleagues throughout the world. He has, for example, been the main protagonist of the concept of the clinic team, which has had such an important influence on the development of prosthetics and orthotics worldwide. Uniquely, Knud Jansen welded together, as equal professionals, therapists, engineers, prosthetists, orthotists, and a variety of medical specialists dedicated to the disabled. They have carried his philosophy to the far corners of the earth. Their work in the "clinic team" is his memorial.

He leaves behind two sons, one of whom is active in the practice of medicine, much-cherished grandchildren, and a wide family of relatives, friends, and colleagues in his beloved Denmark. We join them in their grief and sorrow.

George Murdoch

JOHN D. MALAMAZIAN 1923—1983

An exceptionally effective blind rehabilitation specialist and teacher, beloved by a long line of blinded veterans and rehabilitation professionals who benefitted from knowing him or who were influenced by his work, died unexpectedly on March 10, 1983.

John D. Malamazian was born in Chicago on April 21,