SENSORY AIDS

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Fabrication of Obstacle Detectors for the Blind

Bionic Instruments, Inc., Bala Cynwyd, Pennsylvania 19004
Thomas A. Benham, J. Malvern Benjamin, Jr., D. Ridgeley Bolgiano, and E. Donnell Meeks, Jr.

The prototype unit of the Model C–4 laser typhlocane was completed by the contractor in the Spring of 1967. Trials and demonstrations with the cane were conducted, and it was shown overseas at the 7th International Conference on Medical and Biological Engineering, Stockholm, Sweden, August 1967. Mr. J. M. Benjamin, Jr., one of the developers, presented paper 26–3, "A Laser Cane for the Blind," at the Stockholm meeting. An illustrated abstract appears on page 364 of the meeting digest.

Seven additional Model C–4 laser typhlocanes are being built by Bionic Instruments, Inc., with completion expected prior to July 1968. These canes will embody a number of improvements over the Model C–3 illustrated and described on pages 253–254 of BPR 10–7, the Spring 1967 issue of this publication. Minor changes from the Model C–4 prototype will also be included. The seven new Model C–4 units will have a nylon tip as in earlier models. The lower section of the shaft will be made of a hard, tough, lightweight boron-coated tungsten-reinforced epoxy material. This naturally dark-colored material will be painted white with a specially selected scuff resistant and highly reflecting epoxy material. The boron-composite section terminates about halfway up the cane in a quick-disconnect-type fastening to the magnesium upper section. The disconnect mechanism employs a telescoping action with two resilient "O" rings positioned in retaining channels and allowing sliding adjustment and friction fastening. The rings hold the assembled sections in intimate contact permitting good transmission of vibrations up from the tip, yet permitting prompt disassembly into two sections when the user wishes to stow the cane in a small space. Through improved design the lower or "receiving" nacelle will be smaller in the new units than in the prototype. Interchannel crosstalk will also be reduced. A noise at the unit's pulse repetition rate of 40 p.p.s. due to capacitor dynamics is being reduced by improved design. The separate ON–OFF switch of earlier versions is now combined with the output volume control. The knurled range-setting knob of the Model C–3 is replaced with a smaller lever control in the Model C–4. It has also been possible to reduce the size of the rather large crook which characterized the Model C–3. Improvements in the output

sounder include more permanent fastening to the cane and lower pitched signals.

Use of lighter materials, and the making of several design changes reduces the weight of the Model C–4 to 1⅓ pounds, a significant drop from the 2½ pounds of the Model C–3.

Current plans call for evaluation of the seven units in Fiscal Year 1969 under supervision of VA mobility experts at the centers in Hines, Illinois, and Palo Alto, California.

Spelled-Speech for Automatic Readers Usable by the Blind
Metfessel Laboratories, Inc., Los Angeles, California 90043
Milton Metfessel, Ph. D., and Constance Lovell, Ph. D.

The contractor continues preparation of the final technical report for this project. The report should contain the principal findings of the research as well as information which will enable other workers to produce spelled-speech similar to that produced by Metfessel Laboratories. Current plans call for the report to include both textual and tape-recorded sections.

Research on Audible Outputs of Reading Machines for the Blind
Haskins Laboratories, Inc., New York, N.Y. 10017
Franklin S. Cooper, Ph. D., and Jane Gaitenby

Work continues at Haskins Laboratories with several approaches at different levels on the problem of machine production of relatively natural-sounding speech. One route to the synthesis of such speech is through the process of stringing together appropriate series of phonemes to produce the words. For use in an automatic reading system for the blind, any audible output system depending on phonemic information necessarily must embody a prior grapheme to phoneme stage. Automation of the grapheme-phoneme conversion for English has long been recognized as a formidable problem, but Miss Gaitenby has recently reported some progress towards a usable solution in a paper, "Rules for Word Stress Analysis for Conversion of Print to Synthetic Speech," given at the 74th Meeting of the Acoustical Society of America, November 15, 1967.

Other advances have also been made at Haskins Laboratories since the last report in this series in BPR 10–7. Progress has been made in the area of speech *synthesis by rule,* a method which uses phonemic information as input and then controls one of a number of possible speech synthesizers through application of a set of synthesizing rules which operate on the sequences of input data to produce the output sounds.

Another system being developed at Haskins Laboratories, and already in the laboratory hardware phase, is an updated version of the *compiled speech* process. By use of modern computer and storage techniques, the aim here is to produce word-by-word speech in real time by compiling stored words in the order required by the message at hand. Words not in the store, those in

excess of the 7200 which will be stored in this version, will be spelled out in spelled-speech.

Production of *re-formed speech* is another area of interest at Haskins Laboratories. Moving along, but not as close to realization as *compiled speech,* this type of speech output may be the best for our purposes in the long run. By combining some strengths of the compiling methods, and others of the synthesis-by-rule plans a hybrid scheme which should produce more natural speech than either element alone has been developed.

A short paper by Dr. Franklin S. Cooper, "Haskins Laboratories: Research on Human Communications, Marine Ecology, and the Biochemistry of Protozoa," will be found in Science, Vol. 158, No. 3805, pp. 1213–1215, December 1, 1967. This paper gives an integrated overview of the research at Haskins and helps put into perspective the work being done under VA contract.

Output Characteristics and Construction of an Interim Word-Reading Machine

Haskins Laboratories, Inc., New York, N.Y. 10017
Franklin S. Cooper, Ph. D.

The work on this project has been completed but the press of higher priority more current activities has caused the contractor to delay preparation of the final summary report. Equipment remaining from earlier work on this project has been transferred to the longer term research contract at Haskins described above. This fixed-price contract will be officially closed on receipt and approval of the final report.

The Development and Evaluation of a Personal Reading Machine for the Blind

Mauch Laboratories, Inc., Dayton, Ohio 45439
Hans A. Mauch and Glendon C. Smith

Research on reading machines for the blind has been conducted since 1958 under VA sponsorship at Mauch Laboratories, Inc. Several devices have been developed as a result of this program. Figure 1 is a chart showing the principal elements of the current laboratory-prototype of a home-use recognition reading machine. Concurrently with the development of the recognition system, three other independent reading devices were produced. Using some parts and concepts in common with those of the recognition system, and some different, these three units are represented in Figure 2. The following descriptions and explanations of items shown in Figures 1 and 2 may help clarify for the reader the evolutionary paths which led to the present configuration of devices, their interrelationships, and the function(s) of each of them:

Colineator. (See Fig. 3, p. 109, BPR 10–6.) The unit in the VA-Mauch reading systems which aids in keeping the probe on a line of print, and in changing lines. It comprises a Plexiglas base plate on

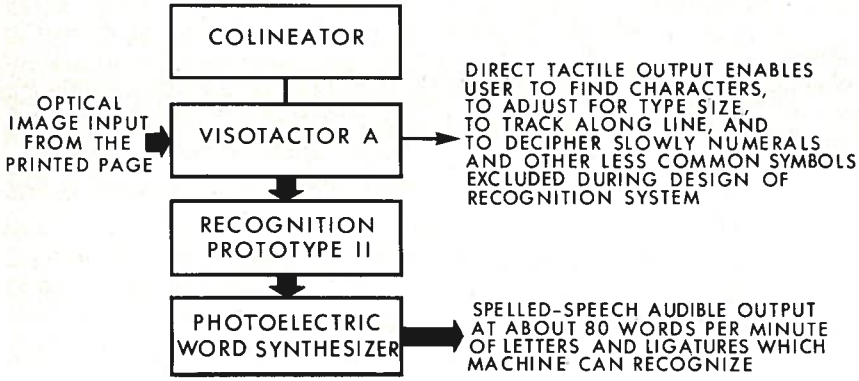

FIGURE 1

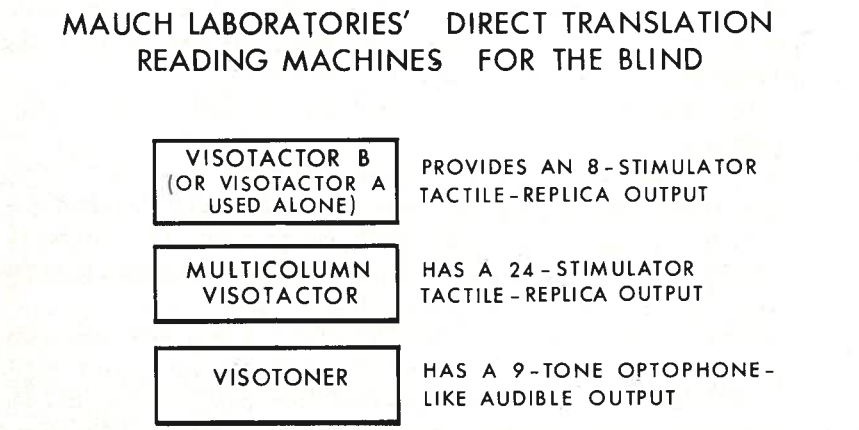

FIGURE 2

which thin materials may be placed or through which thicker books may be read. Precision ground rods and a special roller cross-bearing provide the line-keeping and line-changing capabilities.

Visotactor A. (See Fig. 1, p. 102, BPR 10–6.) This is the optical-probe input unit of the recognition reading system. It comprises a long narrow linear vertical array of eight photocells to control the eight

tactile stimulators used in the "hand" operations of reading, as well as a more complex array used in "recognition" operation.

Recognition Protoype II. This unit contains the circuits which accept information from the 10-photocell array in the Visotactor A used in the letter recognition mode. The processing and logic circuits are improved in this unit to permit faster reading and greater vertical misalignment than was possible before, recognition accuracy being mantained.

Photoelectric Word Synthesizer. Basically a Cognitronics Corporation Model 632 Speechmaker, this unit has additional special control circuitry built by Mauch Laboratories to enable it to function as a producer of spelled-speech audible letter sequences under control of signals from the Recognition Prototype II.

Visotactor B. (See Fig. 3, p. 109, BPR 10–6.) A small, portable, self-contained, battery-powered reading device with tactile output, the Visotactor B is quite similar to the A model described above, but does *not* contain the second and more complex photocell array used as input for the Recognition Prototype II. It is thus not usable in the recognition mode, but only as a "tactile optophone."

Multicolumn Visotactor. (See Fig. 5, p. 115, BPR 10–6.) A self-contained, portable, battery-driven reading unit with tactile output similar to Visotactor B described above, but employing three adjacent linear arrays, each of eight cells, with each cell associated with a corresponding stimulator in three similar linear arrays of stimulators. Thus, 24 stimulators are available to provide two-dimensional patterns rather than only eight as in the B model.

Visotoner. (See Fig. 2, p. 178, BPR 10–5.) A unit that looks very much like the Visotactors described above, the Visotoner is a small, portable, self-contained, battery-powered optophone reading unit for the blind. It has an audible output comprised of combinations of up to nine tones controlled by the shapes of print materials over which it is scanned.

A 61-page year-end report dated June 30, 1967, has been submitted to the VA by Mauch Laboratories. The report provides an overview of the year's work, and is available, while the supply lasts, from the Research and Development Division of the Prosthetic and Sensory Aids Service (see address inside back cover).

Looking towards practical designs for a production model of the recognition reading machine, integrated circuit electronics have been assembled to operate the control and selection functions in the photoelectric word synthesizer now in use (Cognitronics Corporation Model 632 Speechmaker as modified).

Improvement in word-space or end-of-word detection capability has

been achieved by a small change in the design of the recognition photocell array. Minor changes, believed to be improvements, have also been made in the Visotactor-Visotoner line-change mechanism and in the lamp connection and replacement arrangement.

Determination of Performance Attainable With the Battelle Optophone
American Center for Research in Blindness and Rehabilitation, Newton, Massachusetts 02158
Leo H. Riley, M.D., and Mrs. Ruth Morris

A former optophone student who left the program because of illness has returned for weekly lessons. Although she is using one of the two optophones at ACRIBAR, it is still too early to form any judgments as to her success with the machine. The second machine is being overhauled in an attempt to correct an unstable eighth tone.

Evaluation of Ultrasonic Aid for the Blind
American Center for Research in Blindness and Rehabilitation, Newton, Massachusetts 02158
Leo H. Riley, M.D., and Mrs. Ruth Morris

The ultrasonic aids for the blind have been in the hands of six blind people for subjective evaluation in their home and office environments, to supplement more formal evaluation reported in BPR 10–6. Narrative reports from all the trial users are currently being edited and will be compiled into a report. The contractor is also preparing a questionnaire which will be used to elicit additional data from the trial users. It is felt that the narrative reports supplemented by the questionnaire returns will give a reasonably good picture of the reactions of this group of six users in the Boston area.

Reading and Mobility Aids for the Blind, Centrally Directed Clinical Application Program
Central Rehabilitation Section for Visually Impaired and Blinded Veterans, VA Hospital, Hines, Illinois 60141
John D. Malamazian and Harvey L. Lauer

This intra-VA project activated at Hines, Illinois, July 1, 1967, gives formal recognition and increased status to reading-machine work which had been underway there for over four years. Mrs. Genevieve N. Miller, Assistant Chief of the Central Rehabilitation Section, attended a week-long instructor training seminar in May 1963 at Battelle Memorial Institute, Columbus, Ohio. The first VA-Battelle Optophone, Model D, arrived at Hines in March 1964. Soon thereafter Mrs. Miller, using her knowledge as an optophone instructor acquired at the Battelle seminar, commenced teaching the optophone to Mr. Harvey Lauer, a braille instructor on the Hines staff. Mr. Lauer developed keen interest and skill in the method, and with

initiation of this project in Fiscal Year 1968 he became the principal staff member, VA's first Electronic Reading Specialist.

By mid-1967 when this project was formalized and staffed on a full-time basis, use at Hines of the Battelle optophones was for the most part phased out, the newer and smaller VA-Mauch Laboratories Visotoner becoming the principal audio-output device used. Over twelve persons, the majority of them veterans, have been exposed to audible-output reading for the blind at Hines with encouraging though varying degrees of success. It is not yet possible to draw any firm conclusions from this work. Some of these trial users have had even shorter periods of training in Visotactor use, but none has progressed far enough to enable us to estimate the level of accomplishment.

Mr. Lauer has prepared an article, "The Visotoner: A Personal Reading Machine for the Blind," which is being submitted for publication. He also demonstrated Visotoner reading at the Midwest Conference of Home Teachers of the Blind, Columbus, Ohio, September 1967.

Development of Correspondence Courses for Personal Reading Aids for the Blind

The Hadley School for the Blind, Winnetka, Illinois 60093
Donald W. Hathaway and Margaret Butow

A research contract between the Veterans Administration and the Hadley School for the Blind became effective in mid-1967. In general terms the contractor is to develop correspondence courses for training blind and/or deaf-blind persons in the use of personal-type reading machines.

In-residence training with a skilled instructor such as VA has at Hines, Illinois, is considered the best, if not the only, way to learn Visotoner or Visotactor reading. While some veterans live close to Hines, most do not, and travel to Hines for instruction would be costly and disruptive to the normal pursuits of prospective learners. The trip is a sound investment only when we can be reasonably sure of success on the part of the student.

The Hadley School is developing a tape recorded set of introductory lessons which are to be taken by correspondence in the user's home. Results of this series will be used to predict subsequent achievements with the system and will guide VA in selecting veterans for residency training. In currently producing these trial recorded lessons, Hadley draws on its long experience in teaching the blind by correspondence and on the technical knowledge of VA personnel at Hines. It is anticipated that the lessons, once validated, may also be available from Hadley for nonveterans.

Development of Test Procedures for Evaluation of Binaural Hearing Aids
Northwestern University, Evanston, Illinois 60201
Raymond Carhart, Ph. D., and Wayne O. Olsen, Ph. D.

Dr. Olsen presented a paper, "Physical Performance Characteristics of Different Hearing Aids, and Speech Discrimination Scores Achieved with Them by Hearing Impaired Persons," at the November 1967 meeting of the American Speech and Hearing Association, reporting work done on this VA research project. Four hearing aids differing sharply in physical performance characteristics were used in the work, one of the four being tested at two different gain settings, in effect extending the work to five hearing-aid systems. When these aids are ranked in accordance with speech discrimination scores achieved with them, it is interesting to note that this same relative ordering occurs when the aids are ranked according to width of the frequency response (bandwidth) as determined by the HAIC (Hearing Aid Industry Council) method. Thus, for the instruments used, we have a good correlation in this parameter between a user-performance measure (Speech Discrimination Score) and a physical measure (Bandwidth). It should also be mentioned that speech discrimination testing in quiet failed to differentiate performance with the various instruments for individual subjects, but that large differences in scores with the several aids were consistently observed for individual subjects when the tests were done against a competing message background.

Current work on the project involves development of procedures for using shell or dummy hearing-aid cases with active microphones and receivers conventionally placed, but wired to external laboratory amplifiers rather than the usual small amplifier in the aid. Controlled, adjustable amplification will thus be easily available, particularly in regard to the "distortion" parameter which is to be critically studied in the next period. There are also plans to use modulated noise (white noise in 125 millisecond bursts, successive bursts differing 10 dB up or down in intensity) as the competing signal in place of the more complex and difficult-to-replicate competing speech message.

Electroacoustic Characteristics of Hearing Aids
Houston Speech and Hearing Center, Houston, Texas 77025
James Jerger, Ph. D.

Twenty-one commercially available hearing aids which were on the VA contract list for Fiscal Year 1966 were measured for their physical parameters. Important among these parameters are frequency response and harmonic distortion. Ten normals and eleven hearing-impaired listeners were then subjected to a locally prepared sentence intelligibility test (SSI—Synthetic Sentence Identification) using the hearing aids mentioned above. On correlating the subjects' performances with the aids' physical characteris-

tics it was found there was no relation between performance and harmonic distortion measured, but a strong relation with certain aspects of frequency response. Performance was directly related to the extent the frequency response went below 1000 Hz (bandwidth below 1000 Hz), and seemed inversely related to the overall jaggedness of the frequency response curve.

The Effects of Distortion on Hearing Aid Performance

Auditory Research Laboratory, VA Hospital, Washington, D.C. 20422
George Simon, Ph. D.

Dr. Simon, only recently joining this project, devoted this initial period to becoming acquainted with the routines and facilities of his new laboratory surroundings. Because of constructional features at VA Hospital, Washington, D.C., and the location of the Auditory Research Laboratory within the building, it has not been possible to select an area sufficiently isolated from mechanical vibrations to serve as a base for a needed anechoic chamber. Arrangements are in progress with the University of Maryland to build a suitable testing chamber on a contractual basis at a quiet location on their campus.