". . . AND SENSORY AIDS"

. . . an editorial

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Past issues of the Bulletin have concentrated largely on prosthetics, with only brief mention of research on sensory aids in the notes on the VA Contractor Program. In this issue, for the first time, several major papers, in addition to progress reports, describe reading machines for the blind. Hopefully, future issues will be able to publish papers on further improvements—not only on reading machines for type but also for graphical material. From time to time, there also should be discussions of mobility aids for the blind, of magnifiers and other aids for the large numbers of partially sighted among the legally blind, and of hearing aids for the deaf and the hard-of-hearing.

There have been efforts on reading machines since the early years after the recognition of the photoelectric effect. A few machines, developed by outstanding scientists and engineers in several countries and at different times, reached precision construction and some degree of systematic trial. At the end of World War II, the National Research Council's Committee on Sensory Devices supervised an extensive government-financed effort at outstanding laboratories. To a generation accustomed to numerous marvels in other fields, though, the very limited progress on reading machines seemed so disappointing that there was little prospect for support of further research.

Disillusionment among scientists, government sponsors, and others in not reaching immediately the ultimate goal of an inexpensive, high-speed device to allow truly rewarding reading of long passages for great numbers of blind persons may well have led to frustration and overlooking of potentially useful methods suitable for prescription for small, carefully selected, highly motivated, and thoroughly trained segments of the blind population. As one blind man has written, even two words a minute would be infinitely faster than *he* could read!

In this issue our Electronics Engineer, Howard Freiberger, summarizes the Sixth Technical Conference on Reading Machines for the Blind. These meetings arose rather informally in 1954 because our office had found so

many friends who seemed to agree that the burgeoning technology and growing understanding of psychological principles allowed hope for independent reading by blind persons, in spite of repeated past disappointments.

Unhappily, in 1954 many of these more hopeful yet realistic friends of ours did not yet know each other, so we felt that some fostering of friendships and mutual widening of horizons through the conferences might be helpful. Some colleagues were pioneers in the then-visionary field of optical character recognition, others were psychologists or linguists interested in output problems, some were blind engineers themselves or experts in rehabilitation of the blind; all were convinced that something could reasonably be done to give blind people independent access to typed and printed information. Early conferences led to general agreement on a number of different approaches to specific goals, building on past knowledge, applying current technology and ingenious design engineering, and supporting basic and applied research in a variety of related fields.

Fournier D'Albe, the English physicist, just before World War I had worked on a relatively primitive machine which he described in various papers and in his book *The Moon Element, An Introduction to the Wonders of Selenium.* (It has seemed ironical that we have not again heard much about words derived from selene, the classical name for the moon, until the recent years of the space age, yet now a major factor in the currently renewed effort on reading machines is cadmium selenide, a compound of the "moon element.") Immediately after World War I, a production-engineered version of his optophone was built by Barr and Stroud, a well-known engineering firm in Great Britain.

Miss Mary Jameson, who as a blind girl had known Fournier D'Albe and had learned to use the early optophones, contributes a fascinating personal memoir of half a century of work on the problem of independent reading. She has demonstrated tremendous perseverance in struggling with technological inadequacies like horrible signal-to-noise ratios; some psychologists would insist that she has had to tolerate grossly inadequate output displays. All would agree she has patiently used the machines herself and has been a tireless missionary of the concept of making the typed or printed word available to those blind persons—few as they may be—who are *determined* to read in spite of frustrations.

Miss Jameson was almost a legend to some American workers for the blind in the era after World War II; they knew she replied to typed correspondence with touchtyped letters which occasionally carried postscripts apologizing for mistakes which she claimed to have detected with her optophone. To some cynics who "knew" that not even a skilled user could tolerate the very slow speed of the optophone—only a quarter of the speed with which many people typed letter by letter and far slower than the pace of the Talking Book—the notion of such specialized uses seemed ridiculous.

It was a pleasure, therefore, to visit Miss Jameson on many occasions, to verify her performance on everyday tasks, and to learn of her additional uses, such as reading hand-lettered block printing which a friend was sending to her on post cards. A tireless advocate of the optophone for selected users and uses, she had also taught a relatively few others in the British Isles—a teacher, a musician, and others. She used the optophone routinely in the course of her activities as honorary secretary of a group of blind. For many years she has been associated with the research program of St. Dunstan's, the organization for the British war-blinded. In recent years she has had the devoted help of Mr. W. Keith Hill in maintenance and improvement of her machines. On the walls of the room housing her optophone are her citation as a Member of the Order of the British Empire and recognition for declaiming of poetry at a contest. This charming, literate, motivated lady has long been willing to tolerate slow reading speed to achieve independence.

Curiously enough, sighted people tolerate writing at very much slower rates than we demand for speaking and especially for reading. Handwriting and typing are slow per se, and the overall rate for a business letter in words per man-minute expended, counting dictation, shorthand recording, transcription into typing, and proofreading, is very low indeed. Similarly, we do not expect a panacea-like solution in the design of writing instruments. Instead, we accept for specific tasks pocket pens, portable and office typewriters, and typesetting and printing machinery without demanding a single, inexpensive, portable device suitable for all writing tasks.

Shortly after World War II, the Veterans Administration organized a central rehabilitation center for blinded veterans at the VA Hospital, Hines, Illinois, a suburb west of Chicago. Drawing heavily on the staff, the consultants, and the experience of the outstanding Army program at Valley Forge and Avon in World War II, the Hines program achieved substantial success and set the pattern for increasing numbers of other centers. Quite understandably, the emphasis has been on the tried and proven techniques for mobility, communication, personal adjustment, vocational training, daily living, etc. The Hines center has taught a limited level of skill in braille to all patients for obviously valuable independent uses like reading labels on articles for the blind (e.g., Talking Book records) or privately labeling materials such as medicine bottles, canned goods, and boxes. This initial skill also served as a foundation for those (admittedly few) who chose to pursue braille skills toward the much higher speeds attained by students trained during childhood in schools for the blind.

Braille is excellent—when it is available, known, and accepted. Unfortunately, only a small fraction of the printed material readily accessible to the sighted population has been transcribed into braille; practically

none of the typed or duplicated material of limited but often important circulation is in braille. Relatively few blind persons are skillful in braille. As but one example, a study of recreational habits of blind persons showed that ony 28 percent claimed to know braille and only 7 percent drew as much as one braille book per year from the free circulating libraries sponsored through the Library of Congress and the state or local governments. Nevertheless, the Hines staff rightly recognized the importance of some acquaintance with braille for auxiliary uses even in the absence of rewarding reading speeds and skills suitable for prolonged reading of entire books.

In much the same spirit, Mr. Apple, the current chief of rehabilitation for visually impaired and blinded veterans at Hines, has perceived, as he tells us, the possible value of similar rudimentary skills with the very limited experimental reading machines which are beginning to emerge from the PSAS research program. He readily agreed to have Mrs. Miller of his staff trained as a teacher of the lengthy training course developed at Battelle Memorial Institute under VA auspices for its version of the optophone. Mrs. Miller initiated the training of Mr. Lauer, the blind braille therapist who describes so enthusiastically herein his later self-study program and further progress.

With the assistance of the Hines Orthopedic Brace Shop (another PSAS activity), Mr. Lauer also has developed a motorized tracking board and a carriage to assist in moving the Battelle probe over the line of print at uniform speed, extending ideas developed by Mr. Freiberger alone or with the assistance of the VA Prosthetics Center in New York. The favorable results of smoother pacing, long emphasized by Miss Jameson based on her experience with the Barr and Stroud precision apparatus, must be balanced against the somewhat greater complexity, weight, bulk, and cost of tracking aids. Some of us concerned with the restimulation of the optophone concept, in spite of the obvious and historically proven limitations of long training and inherently slow speed, have tended to stress the need for portability and simplicity in spite of the fact that unaided manual tracking forces further reductions in already limited speed. The *total* time to read a brief message, a check, a telephone number, or a label, or to identify paper money is mainly a function of availability and setup time of a reader, not so much of reading speed within the message.

The further miniaturization of the optophone principle exemplified in the Mauch Visotoner, using the same tone patterns as the Battelle, has been welcomed by Mr. Lauer. He has used the machine in its simplest hand-held form to read labels on packages in supermarkets and in similar tasks, supplementing more formal reading with the aid of the Colineator tracking device.

A device looking very much like the Mauch Visotoner is the Visotactor developed earlier at the same laboratory. Its tactile rather than audible

output is particularly suitable for use by deaf-blind persons, though it can be used by other blind persons. The Visotactor A was originally conceived primarily for carrying the more complex photocell array and supplementing the functions of the complete recognition reading machine for higher speed with spelled output which Mauch Laboratories hope to complete in future years. In the meantime, a blind subject has completed the 200-lesson Battelle optophone course using the simpler Visotactor B. She read adult material at over 7 words per minute at the close of the training series.

On this centenary of the birth of Anne Sullivan Macy, the famous teacher of Helen Keller, we are particularly reminded of the special problems of the deaf-blind. The Mauch Visotactor with tactile output was demonstrated privately to Robert Smithdas, the deaf-blind Handicapped American of the Year. Soon afterward the companion Mauch Visotoner with audible output was demonstrated by Mr. Lauer at the annual meeting of the President's Committee on Employment of the Handicapped. One can imagine numerous employment possibilities from such devices, limited though they inevitably are in speed, precisely because of their possibilities for independent and prompt deciphering of elusive, tantalizing inkprint and typescript—and engraving on paper money.

Evaluation is a difficult task at best. It can be further confused by misunderstandings of goal and by unrealistic minimum scores demanded for "success." A reading system requiring extensive training, demanding some manual skills, and used routinely by only a very small percentage is rightly recognized as of great value if it has a long, perhaps turbulent, but ultimately successful history, like braille. Such limitations in a new electronic device would lead to rejection. Fortunately, the present generation of electronic devices, while far from universally successful, already have received much higher percentages of acceptance among the blind subjects tested.

In spite of these somewhat encouraging signs of specialized uses of very limited machines at very slow speeds, the real goal is rewardingly high speed with only negligible training and at only mild psychological pressure or stress. Even so, any electronic reading system which we now envision can only supplement, not replace, the various existing systems such as sighted readers, braille, records, and tape. Each of these has both advantages and disadvantages.

Sighted volunteers are often available at certain times and places, at no economic cost but at intangible costs of delay, compromised privacy, and perhaps implications of censorship. Paid readers, though excellent, are expensive and are available only as scheduled. Braille, as we have seen, is only sparsely used, especially by the adventitiously blinded adult, in spite of its potentially adequate reading speed and its value for preparing and reading back one's own notes and manuscripts. The Talking Book (which

introduced 33 rpm records fifteen years before routine commercial use of long-playing records) is very widely used for both study and recreation, and dictating machine records or tapes have been used effectively for texts. In spite of rapid increases in numbers of books and magazines recorded in spoken form in recent years, these excellent systems are obtainable for only a very limited portion of the total inkprint available to the sighted reader. The rather recent availability of inexpensive portable tape recorders has helped to reduce the problem of personal correspondence with understanding and cooperative friends. These aids, however, do not provide for bank statements, proofreading of one's own touchtyping, or other functions normally requiring vision but scarcely recognized as literary "reading."

This distinction contrasting long-term reading of major books or magazine articles with short-term deciphering of brief but important passages, notes, or figures may not have been clearly recognized in some past efforts. This difference may be compared with the problems of fluent translation of a foreign language contrasted to slight but valuable "guessing" ability to read menus, street signs, time tables, and the like without seeking a truly competent translator. Many of the Ph. D. candidates passing their foreign language examinations have very limited reading speed indeed, yet they have attained some slight confidence in their ability to tackle a foreign reference independently—or at least to translate a title and rule out its applicability!

The more sophisticated reading systems, though, must approach the ability to translate fairly smoothly at sight, even if not the ability to read one's native language silently at the speeds now urged by courses in rapid reading. Such machines are still some years in the future. The advances in computers, machine translation, linguistics, and psychology give increasing hope for rapid reading machines. (Some even dream of artificial vision.)

Nevertheless, a serious and sustained effort on a spectrum of projects pointed specifically toward the problems of the blind seems necessary to capitalize on advances in other fields. Originally, there was general agreement that there was no likelihood that commercial character-reading machines would be directly useful for the blind because the major commercial applications were for very high reading speeds on very limited choices among "cooperative" characters, often only ten digits, in a single font and in a prescribed location on a standard single-sheet document like a check. While there has been growing experimentation on multi-font machines and on even more complex tracking mechanisms suited to bound magazines or books, the general supposition still holds.

Likewise, there seemed little probability of commercial use of machines producing spoken letters, digits, or words once the characters were known. Thus, for the special needs of the blind the studies at Metfessel Laboratories on "spelled-speech" and at Haskins Laboratories on various means of pro-

ducing spoken English words and sentences have seemed important to the VA program. While fortunately there is now some commercial interest in spoken output of computer storage, stock market quotations, telephone numbers, or the like, the present applications typically require only small vocabularies compared with our goals. Likewise, brief commercial messages may not require strict conformity with such linguistic standards as Miss Gaitenby of Haskins discusses herein, yet these rules for intonation and duration should be followed in a reading machine intended to provide to the blind comfortably speech-like output of lengthy texts.

A large fraction of the legally blind fortunately have some partial sight, so every effort should be made to assist such patients by high-power prescriptions in spectacles, by magnifiers and illuminating systems, by telescopes to read distant street signs, and especially by careful and prolonged counseling and follow-up examinations. Some partially sighted patients can travel safely without further mobility aids, yet even with the best magnifying systems they cannot read ordinary print. Such cases, as well as the totally blind, should benefit first within the next few years from slow deciphering equipment requiring extensive training and later from more elaborate electronic reading machines capable of assuming more of the burden of bringing the printed word automatically to those now deprived of independent reading.