DEPLOYMENT OF READING MACHINES FOR THE BLIND

Howard Freiberger, A.M.
Electronics Engineer

Research and Development Division
Prosthetic and Sensory Aids Service
Veterans Administration
252 Seventh Avenue, New York. N.Y. 10001

INTRODUCTION

Sensory aids for the blind have seldom achieved the status of routinely used items among blind people without rather extended, expensive, and sometimes exasperating "deployment phases." Postulating a system comprising three elements, those desiring to introduce a device, the device itself, and the blind population meant to benefit from the device, it comes as no surprise that factors related to each of these three categories contribute to deployment problems. Some of these factors are discussed in the following section.

Those Desiring To Introduce a Device

Sometimes it seems that inventors or researchers develop a device and *then* look for the problem it was intended to solve. The late John K. Dupress, himself a blinded veteran with a major upper-extremity amputation, frequently spoke in such terms about the inadequate assessments of needs to be met and the ensuing premature development of sensory-aids devices.

Often the device alone is presented as the complete package to serve as a great boon to the disabled. Woefully neglected are real-life practical considerations, such as production, distribution, maintenance, and repair. Training plans, materials, and arrangements are also seldom considered.

It is usually difficult to attract private capital to the rehabilitation-device field, so advances must often await government, foundation, or interested-agency support. With the unending competition for the dollar among many worthwhile social programs, and considering what sometimes seem to be only marginal replacements man can make to ameliorate problems caused by human sensory dysfunction, such organizational support is often hard to come by. This leads to a nonproductive cycle—no reasonable number of devices, hence no reasonable number of

effective users to create confidence in and a demand for the devices, hence no reasonable number of devices . . . .

The Device Itself

Devices have been criticized as being insufficiently rugged, unreliable, too large, too heavy, too costly, clumsy and lacking human-factors design considerations, and too hard or troublesome to use or to learn to use.

A device which marks a person as special, disabled, or different, or which tends to draw additional attention to an already obvious disability generally meets with disfavor from most disabled people.

If the everyday use and maintenance of a device cause more weighty problems and annoyances than can be ameliorated through use of the device, it is not likely to become a routinely employed sensory aid.

The Blind Population Meant To Benefit From the Device

There is no monolithic, homogeneous class, "The Blind." Rather, blind people constitute an aggregate of humans reflecting just about every individual difference found in any large group. Their needs, desires, aspirations, educations, vocations, avocations, personalities, and adjustments to life run the gamut as indeed do their various levels of useful vision. The totally blind, of course, see nothing with their eyes, but with this as datum, people meeting the various standards for legal blindness have increasing amounts of useful vision up to and including sufficient sight to allow relatively unencumbered travel and reading of certain materials. Each person's visual problems are peculiarly his own which makes for need of a grand armamentarium of devices if each person is best to be served with sensory aids. The lack of universality of application of sensory aids reduces the number of any one device needed, raises the unit cost, and discourages mass-market-oriented manufacturers.

Blind people, employed or even unemployed, sometimes resist the disruption in the regular flow of their lives occasioned by the need to go to a training center to learn some new skill associated with a sensory aid. Many cannot afford expensive devices, training programs, or maintenance regimens. Many weigh carefully, and rightfully so, the investment they must make (in time and energy as well as in money) to learn a skill against the foreseen benefits. If the benefits do not seem impressive, people will tend to pass the opportunity by.

Our great communications media and years of popularization of science have finally brought to most people some inkling of current developments in technology and the rapid rate at which such advances occur. Given a sensory aid at any point in time, if it has been suitably conceived, researched, developed, and produced, it is likely to be, at least in some of its elements, on the verge of obsolescence. People, naturally wary of the merits of a new device, learning of conditions of near

obsolescence, are prone to set aside the instrument in hand to await the improved next-generation device, which regrettably can suffer the same fate.

Having delineated some of the factors which seem to conspire to retard the deployment of sensory aids for the blind, a particular example of such a sensory device—the portable, individually owned reading machine —will now be discussed.

THE PORTABLE READING MACHINE

The advantages accruing to a blind person able independently to read ordinary inkprint surely must have intrigued Dr. E. E. Fournier d'Albe who described a "reading optophone" in a 1913 issue of the British journal "The Electrician." He had been pondering instruments such as Alexander Graham Bell's photophone for some years before, and at the Optical Convention of the United Kingdom, South Kensington, June 25, 1912, showed a device to enable a blind person to locate lights by means of corresponding sounds it produced. This early work by Fournier d'Albe is often considered the inaugural effort in the still-continuing search for a device which will give large numbers of blind people the ability independently to read graphic materials of their choice.

By 1917 Miss Mary Jameson, whom we have since come to recognize as a British pioneer in polyphonic reading for the blind, had been introduced to Fournier d'Albe's optophone. She has continued to use successively modernized versions of the optophone to the present day, teaching the skill to others, and stimulating research aimed at improving the reading means available to blind persons.

Messrs. Barr, Stroud, and Fournier d'Albe were issued U.S. Patent No. 1,350,954 August 24, 1920, on the "Optophone." Brief tests and demonstrations were made in the United States in the twenties, but the system did not gain any followers here. Miss Jameson used the machine built by Barr and Stroud for many years. In 1944 St. Dunstan's, a British organization for men and women blinded during war service, sponsored some improvements to modernize the machine being used by Miss Jameson.

During World War II heightened concern over ameliorating the problems caused by blindness led in January 1944 to establishment in the United States of the Committee on Sensory Devices which tried to bring to bear in the solution of these problems the strengths of the technological and psychological communities. Polyphonic reading devices of those years included machines developed by Morton and Flory at RCA (U.S. Patent No. 2,420,716 "Reading Aid for the Blind," issued May 20, 1947), by Zworykin and Hillier at RCA (U.S. Patent No. 2,451,014 "Optophone," issued October 12, 1948), and by Zworykin and

Flory at RCA (U.S. Patent No. 2,457,099 "Electronic Reading Aid for the Blind," issued December 21, 1948). Only the latter device, known as the RCA A-2 Reader, was produced in any quantity, 25 copies comprising the run. Limited trials and some formal evaluation by Dr. Wilma Donahue at the University of Michigan under Veterans Administration (VA) auspices showed reading systems employing these devices to be marginal in terms of providing blind people the capability independently to read ordinary print. More work seemed indicated not only on the devices themselves but also on problems related to procurement of units, selection and training of instructors and prospective users, means of training, location of schools, and provisions for followup, maintenance, and repair.

The Veterans Administration maintained its interest in reading machines for the blind over the intervening years and on August 20, 1954, arranged the first Technical Session on Reading Machines for the Blind at Toledo, Ohio, under the chairmanship of Professor T. A. Benham. Subsequent sessions have been held when circumstances seemed to indicate the need for another meeting, the sixth and most recent having been held January 27 and 28, 1966, at the Veterans Administration Central Office in Washington, D.C. Deliberations at these technical sessions led the VA actively to support reading-machine research again when contracts were let in 1955 and 1957 with the University of Southern California and Haskins Laboratories, Inc., respectively for studies on audible outputs for reading machines. Work on improving polyphonic reading devices themselves commenced on April 15, 1957, with a contract between VA and Battelle Memorial Institute for the development and evaluation of aural reading devices for the blind. The Battelle work culminated in the production of 10 copies of a quite rugged, fairly reliable, portable Model D Optophone fitted into a standard ladies' train case. A major effort at Battelle led to a 200-hour training course comprising tape-recorded and inkprint materials based on successive improvements of their earlier 65- and 135-lesson courses.

Almost concurrently with the work at Battelle, VA-sponsored work at the now Mauch Laboratories, Inc., commenced with an August 1, 1957, contract to produce a personal-type reading machine for the blind. Still active, researchers on this contract have produced several instruments to date. In May 1967 Mauch Laboratories, Inc., delivered to the VA six Visotoners and four Visotactors, all complete sets with Colineator tracking aids and auxiliary equipment, all fitted into attaché cases. By April 1969 VA owned a total of 36 Visotoner and 14 Visotactor sets. Both the Visotoner and Visotactor are direct translation reading machines, one with optophone-type audible output, the other with a tactile output. The Colineator, usable with either, aids in the tracking of these devices along lines of print. Current experimental developments at Mauch

Laboratories include a recognition machine with spelled-speech output (the Cognodictor), and a hand-held tactile-output device called Digitactor.

The technological developments at Mauch Laboratories have been supplemented by blind-user oriented work at VA's Central Rehabilitation Section for Visually Impaired and Blinded Veterans, Hines, Illinois, and at The Hadley School for the Blind, Winnetka, Illinois. Mrs. Genevieve N. Miller, then Assistant Chief of the Blind Rehabilitation Section at Hines VA Hospital, attended a week-long seminar in "Use of the Battelle Aural Reading Device for the Blind," May 13–17, 1963, at Battelle Memorial Institute. She then served as instructor in optophone reading to Mr. Harvey L. Lauer, a staff member of the Hines Blind Rehabilitation Section. Mr. Lauer in turn instructed Miss Margaret Butow, a staff member at The Hadley School for the Blind. These early efforts were formalized in 1967 by establishing a centrally directed program at Hines and by a contract with Hadley.

Mr. Harvey Lauer at Hines worked to make himself the most proficient polyphonic reader in the country, to train others to be instructors in the skill, to train veterans, to explore new uses for the devices, to develop recommendations for improvements, and to assess selection criteria for those interested in the skill. Miss Margaret Butow at Hadley, now also an accomplished user of the Visotoner, has developed explanatory and screening tape-recorded materials for home use to enable prospective reading machine users to acquire realistic notions of the system and of their capabilities and desires to pursue it. The first eight graduates of the Hadley course who have been able to obtain personal training at Hines VAH from Mr. Lauer have demonstrated both capability and motivation.

While the aforementioned reading-machine activities were taking place, other researchers were also developing somewhat different systems. One which has been brought to a stage of development roughly comparable to that of the Visotoner is the Optacon (*Op*tical to *Tac*tile *Con*verter) built at Stanford Research Institute, Menlo Park, California. This device will not be further discussed in this study however, as the aim is analysis of the deployment problems for one system, the Visotoner, and production of a plan to achieve its deployment. To plan for deployment of a mix of the two instruments seems beyond the scope of the present study. Separate analyses logically should be made for the Optacon and its deployment. Some blind people, for physical or physiological reasons, may not be able to sense the output of the Optacon. Conversely, others will not be able to make much of the sounds of the Visotoner. For such people the alternative machine is obviously indicated. Some blind people are thought to be tactually oriented, others favor the sonic milieu—for these groups choice of system also seems straightforward.

Many of the skills associated with successful use of one type of instrument are thought to be quite transferable to other kinds of instruments: if so, learning one will not be a waste of effort should a person later change to a new instrument using the other sense or an improved version using the same one.

While the mainly technological events described above were occurring over the past half century or so, other changes strongly influencing the subject of independent reading by the blind were also taking place. These include changes in the attitudes of the sighted towards the blind, changes in the rationale of rehabilitation practices employed by counselors of the blind, and the movement of increasing proportions of blind people into and through institutions of higher learning leading to more employment and chances for employment in a variety of professional, technical, and other areas where previously a blind person was rarely hired. The shift from the often beautiful Spencerian script renditions of all manner of business and professional communications to the current widespread use of typewritten, machine, and computer imprinted materials has added notably to the value of being able independently to read such materials. Even being able to read only the "0" or "1" characters which comprise some computer printouts would be of value. The general increase in literacy over the past few centuries also increases the urgency that one be able to read. Direct translation machines could be introduced to blind school children first as an extracurricular hobby for a selected few, somewhat as Miss Ann Chapman of Columbia Lighthouse for the Blind, Washington, D.C., did during the summer of 1970, and then, if successful, more students could be involved.

The two chains of events outlined above, showing the ever increasing need to read inkprint and the availability of comparatively practical systems for enabling the blind to do just this, leave us in 1971 with a well-defined social need and several well-engineered means to satisfy it. What seems yet to be lacking is the deployment system to get the machines capable of satisfying the need together with the people evidencing the need. It is to analyze contributing factors and to propose such a system that this paper is being written.

Successfully deployed reading-machine systems for the blind will involve at least the following elements:

Reading machines (availability is a necessary condition, often conceived as the major goal, yet it is only a first step)
Distribution or deployment channels for the machines
Teachers of reading-machine reading
Blind persons doing useful independent reading of inkprint
Servicing and maintenance facilities
Ongoing research to improve the systems

These elements plainly are not independent of one another. At current

machine costs, usually in the order of one or more thousands of dollars each, reading-machine proponents are hard pressed to get funds for machine procurement without having a register of identified blind persons who are prospective users. To identify such blind people has been a problem as few come forward convincingly as prospective users of machines they have not yet tried. Also the lack of machines and a "student body" understandably has operated to discourage persons from investing the time and effort necessary for becoming a teacher of the skill. Small inroads into each of these difficult areas have already been made by the Veterans Administration and by Stanford Research Institute, but in each case the net result so far still is a subcritical system, one in danger of fading away if left to itself. To bring the system up to a level where it will be more or less self-sustaining, and thus a viable, practical rehabilitation tool, will require more machines, more teachers, and more students. Persons from the nonveteran blind community and workers ministering to it seem the appropriate ones to swell the numbers of students and teachers, while agencies charged with rehabilitation of the handicapped of many varying ages and backgrounds would seem to be the logical sources of necessary additional funds for machine procurement and program support. A period of joint operations thus seems indicated, the Veterans Administration supplying information, designs, some skilled personnel, and appropriate funds to meet the projected veteran client load, nonveteran agencies contributing commensurately with their clients' needs.

The question then arises as to what the scale of this joint deployment effort should be. Some factors to be considered when seeking the answer are:

Current experience with reading machines
The size of the blind community
The number of persons expressing an interest
The numbers using other reading systems
The number of instructors already available and potentially achievable
The unit costs and total funds available for the program
The "absorption" rate of new machines into the community
The vocational requirements for independent reading
The willingness of persons to "invest" in learning present systems when better ones are in the offing, and the appropriateness of suggesting such investment to selected blind persons and to agencies
The gains achievable after mastering reading-machine system skills versus the investment necessary to achieve such skill levels
The numbers really desiring to read independently
The distribution of blindness with age, and the influence of age on learning a complex new skill

These factors are neither all-inclusive nor mutually exclusive. Where a quantitative statistic seems involved, it is likely only imprecise data are available. Evaluation of some of the factors can be done only by making educated estimates.

Projections indicate there will be some 500,000 legally blind persons in the United States in the mid-1970's. Blinded veterans with some compensable service-connected condition would seem to comprise about 2 percent of this total. All members of these groups clearly are not candidates for reading machines of the kinds under discussion. Hopefully, far better solutions will become available—but these are years away from widespread deployment, and even under ideal conditions their use may require some of the same skills necessary for use of the present direct-translation devices. Some who are legally blind are able to read with the aid of magnifying equipment, others will be insufficiently motivated to master a reading-machine system, some will lack mental or physical attributes necessary for success, others will be unable or unwilling to invest the effort necessary to acquire the skill. On the other side of the coin there are blind people who strongly desire to read inkprint independently, or who would evidence such desire given the availability of a practical reading system.

As there are only a few dozen or so users of reading machines at the present time, the scale of the inaugural deployment program should be such as to satisfy that very minor fraction of the 500,000 deemed likely to be successful users. The reading-machine requirements for those becoming blind in the future will be smaller and strongly subject to the influences of new developments in machines and in changes in the incidence of blindness in the population. The idea of a one-time initial effort to satisfy the backlog of blind persons never given an opportunity to have a reading machine, followed by a reduced future schedule, is appealing from some viewpoints, but poses large problems related to the temporary character of the initial operations. Well-qualified staff personnel are harder to develop for temporary programs, and costs inevitably are higher. This would seem to indicate the wisdom of a more gradual attack on the bloc of current potential users than first predictions might suggest.

Using the 500,000 legally blind people expected by the mid-1970's as a base, and even this action is subject to some question and has areas of invalidity, an assessment will be made of the size of the subpopulation within the 500,000 for whom reading-machine services with existing types of machines should be considered. It has been estimated that 12,000 visually impaired people use braille ["Characteristics of Visually Impaired Persons—United States—July 1953 to June 1954." Nat. Ctr. for Health Statistics Pub. Series 10, No. 46, PHS, HEW]. Let us say by the mid-1970's this figure could be 13,000. Just as a measure of peoples'

willingness to learn and practice a reasonably difficult system this would seem to indicate only about 2.6 percent of our 500,000 put forth the necessary effort. Intuitively it is felt that effort and interest can be expected from about the same or most probably an even smaller percentage of the 500,000 in connection with electronic reading machines. Perhaps a population of 5000 prospective reading-machine users could be deduced by this rather elliptical reasoning. Trials, perhaps first as an extracurricular hobby, in schools or classes for blind children would seem important; all evidence points to routine use of braille by such students and alumni in contrast to limited use by adventitiously blinded adults.

Over a period of years inquiries and expressions of interest have been coming in to the Veterans Administration, The Hadley School, and Mauch Laboratories, Inc. An estimated 200 such independent expressions of interest have been received, not only from prospective users *and* workers in the field but also from persons having commercial interests and those having only a general interest. While independent reading of inkprint by the blind is a dramatic type of story which has been brought before the public on a number of occasions, activity to introduce the system has not matched that associated with introducing braille to blind people. With more publicity and information-dissemination activities perhaps the 200 inquiries would escalate to 2000 or 5000. Projecting from current experience at The Hadley School where only 10–20 percent of inquirers seem to materialize into good prospective users, we might deduce optimistically a population of some 1000 prospective reading-machine users.

Table 1 provides a summary of selected data on eight veterans and 10 nonveterans who have achieved some capability with the Visotoner or its predecessors, the Battelle Optophone or the British Optophone. Reading speeds in words per minute (wpm) are not shown in instances where these figures are not reliably known. It should be noted that reading speed in wpm, at first glance often considered a very valuable and indispensable measure of worth, is not really a principal indicator of the benefits to an individual of reading inkprint independently. In Table 2 are shown some of the uses reported by the 18 people listed in Table 1. An assessment of the values to blind people of being able to read even at low speeds is facilitated by consideration of the wide range of useful activities mentioned in Table 2.

Quite roughly then it would seem there is a potential population in the order of a few thousands for direct-translation, home-type reading machines for the blind. Considering the reasoning already set forth above that the whole bloc not be serviced at once, but rather gradually, a good target figure for current planning is 1000. If we make the further bold assumption that half of these people will be tactually oriented, and

TABLE 1

Subject	Location	Age	Vocation	Training Hadley	Training Hines	Reported Uses (see Table 2)	Remarks
			VETERANS				
A	Calif.	48	Teacher	*	*	1,2,12	Reads 15 wpm.
B	Kansas	43	Rehab. Worker	*	*	3.6	Reads a variety of print
C	Wash.	28	Student		*	1,5,24	
D	Illinois	50	Unempl.		*	13,22,23	Persistent, Reads 12 wpm.
E	Michigan	30	Student		*	1,7	Has useful skills.
F	Illinois	24	Student		*	1,10	Reads simple texts slowly.
G	Texas	33	Student		*	10,20	Excellent ability with code.
H	Okla.	51	Unempl.		*	1,2,7	Reads good print slowly.
			NON-VETERANS				
I	Illinois	33	Teacher	*	*	1,2,3,4,6,11	Reads 25 wpm.
J	D.C.	61	Teacher	*	*	3	Reads good print slowly.
K [a]	Ohio	71	Retired			1,13,14,21	Reads 25 wpm, Battelle device.
L	Maryland	30	Mathematician	*	*	1,10	Reads good print slowly.
M [b]	England	72	Reading Machines			1,2,3,7,11,14	Pioneer in field. Reads 40 wpm.
N	Illinois	37	Reading Machines	*	*	2,3,4,6,16,17	Reads 40 wpm. Accomplished teacher.
O [c]	Michigan	56	Teacher	*	*		Moderate ability, Potential instructor.
P	Illinois	53	Teacher	*	*	3,10	Potential instructor.
Q	England	37	Teacher	*		14	Teaches music in elementary school.
R	Mass.	53	Needlework			13,19	Reads about 6 wpm.

[a] Uses the Battelle Model D Optophone.
[b] Long-time user of British Optophone. Uses Visotoner too.
[c] Potential principally as teacher rather than user.

half auditorily more proficient, we can come up with a total target population of 500 to be equipped with Visotoner reading-machine sets.

To activate a system with 500 users we would first have to identify the select 500. Some means for doing this exist. The screening course developed at The Hadley School for the Blind could be used as one selection instrument to check both ability to learn the code and motivation to do so. Additionally, some nonpublished work by Harvey Lauer

TABLE 2.—*Summary of Reported Uses for the Visotoner Reading Device Showing Numbers Reporting*

Use No.	Uses	No. of persons reporting
1	Proofreads own typing	10
2	Reads typewritten-personal correspondence	9
3	Reads typewritten business correspondence	4
4	Reads addresses on envelopes	3
5	Identifies printed or typewritten materials	3
6	Reads labels (printed or typed)	3
7	Reads short articles	3
8	Picks up where left off when interrupted in typing	2
9	Locates place on form, letterhead, to type	2
10	Identifies mail	2
11	Reads directions or instructions	2
12	Reads advertisements	2
13	Reads magazines	2
14	Reads from books	2
15	Checks corrected typing (Korekto-type)	1
16	Reads bank statements	1
17	Reads utility company bills, etc.	1
18	Reads forms	1
19	Identifies paper currency	1
20	Reads mimeographed college materials	1
21	Reads Bible	1
22	Reads wife's typed or printed stories	1
23	Reads for pleasure, as a hobby	1
24	Conducts research	1

describes a system for arriving at a quantitative predictor of success with reading machines. This well-conceived instrument could also be applied to the selection process along with necessary interviews to determine details in each situation.

Procurement of machines and preparation for instructional activities should proceed so that some students, teachers, and machines are ready at about the same calendar date. Engineering drawings in a form suitable for advertising for bids have already been prepared by Mauch Laboratories for the Visotoner set. The last (1967) unit cost of the set [a] was $1875.00 each in a quantity of 40 (that is, 30 Visotoners and 10 Visotactors of comparable size and complexity). Costs have risen since, but economies can be expected on an order for 500 units, and a cost of $1500.00 per set, or $750,000.00 total material cost seems plausible.

The people otherwise found to meet the selection criteria will prob-

[a] Each set comprises a Visotoner, earphone, and rechargeable battery in a leather case comparable in size to a hard-cover book; also a Colineator tracking aid, spare battery, battery charger, and attaché case for all the equipment.

ably turn out *not* to be ordinary people, but will be of an exceptional group. They will not have time on their hands and the 6 weeks of equivalent full time [b] considered essential for a reading-machine learning period cannot be given by them without hardship. An instructor could probably handle three students in intensive training at a time. A nationwide faculty of 11 instructors would thus be able to give instruction to our 500 students for 6 weeks each over a 2-year period. Personnel and support costs of about $20,000.00 per year per instructor seem about correct, so the instructional staff for 2 years would cost in round figures about $500,000.00.

Instructor recruitment and development has in some degree already started, and it is felt the training of a dozen or so instructors could be done utilizing present specialists and a few yet to be more fully developed.

Just what the future will bring is difficult, as usual, to forecast. Estimates as to the number of Perkins Braillers needed to satisfy the blind community's needs were far too low. Early predictions of a market for 5,000 Perkins Braillers were thought by some to be ridiculously high. The demand was such, however, that gradual increases over the 5,000 estimate failed to meet requirements, and now over 50,000 units have been distributed throughout the world. The Perkins device is *still* being manufactured and sold satisfying the demand created by new blind people, probably quite a few others not previously having a machine, sighted transcribers, and the foreign market. The demand for polyphonic reading machines may similarly burgeon, or it may subside with the development of improved systems enabling blind people to read independently. Nevertheless, a direct-translation device most likely will be smaller, more portable, and less costly than a full recognition system providing higher speed, less learning time, and less effort. Thus, like the pen in comparison with the typewriter, it may retain a concurrent role. The quantity, 500, and the time scale and level of instructor support suggested above would seem about correct at this time for the reasons indicated.

ACKNOWLEDGMENTS

The continuing work of Mr. Harvey L. Lauer at the Central Rehabilitation Section for Visually Impaired and Blinded Veterans, VA Hospital, Hines, Illinois, and Miss Margaret Butow at The Hadley School for the Blind, Winnetka, Illinois, is acknowledged as the source of much of the information in this paper dealing with reading-machine users and uses, particularly the data in Tables 1 and 2.

[b] Screening course by correspondence; a minimum of 2 weeks and preferably longer full-time instruction; intensive part-time training and practice over a year or so.

SUMMARY

In this paper the history of reading-machine developments for the past half century or so is sketched along with reference to concurrent changes in the attitudes toward blindness and the blind and vocational and educational advances made by the blind. It is suggested that now in 1971 there is a well-defined need that certain blind people be able independently to read limited amounts of inkprint. There are also extant in 1971 several devices with either audible or tactile outputs, developed under various sponsors, permitting blind people to do just this. The need, and means to satisfy it, being both present, a program is then outlined whereby one style of available reading machine could be deployed to a population of at least some 500 blind persons believed to have the potential for successfully using the system. Such devices should be immediately useful to small numbers of carefully selected blind people. They should be of value to persons in the computer industry even if only to read the "0" and "1" characters comprising some printouts. They should also help prepare users for the more sophisticated machines and perhaps telephone-connected systems expected some years from now, but should remain useful because of their portability even when other systems become widely available.