

ST. DUNSTAN'S INTERNATIONAL CONFERENCE ON SENSORY DEVICES FOR THE BLIND

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INTRODUCTION

St. Dunstan's, a British organization for men and women blinded in war service, with headquarters at 191 Marylebone Road, London, N.W.1, invited the writer to attend an International Conference on Sensory Devices for the Blind. The Conference was held June 13-17, 1966, at the Great Western Royal Hotel, Paddington, London, W.2, England. The program comprised twenty-seven papers, introductory and concluding remarks, a visit to the National Physical Laboratory, two evening workshop sessions, luncheons, dinners, receptions, and ample opportunities for informal discussions between those present. Sixteen papers were presented by speakers from the United States, five from the United Kingdom, and one each from Australia, Austria, Canada, France, Netherlands, and New Zealand. The roster of delegates and participants distributed at the conference showed that of a total of eighty-nine listed, fifty-four were from the United Kingdom, eighteen from the United States, four from Germany, three from France, two each from Canada, Netherlands, and Sweden, and one each from Australia, Austria, Denmark, and New Zealand. A directory of all persons mentioned in this article will be found at the end.

The Conference was opened Monday morning, June 13, 1966, with an address of welcome by St. Dunstan's chairman, The Lord Fraser of Lonsdale, C.H.^a He stated that whatever was said or done here at these sessions, blindness still remains a serious disability. Many World War II airmen and gunners who used radar in the military, later as blinded ex-servicemen often had intuitive feelings that electronics, which provided the "seeing" properties of radar, could somehow help solve their mobility problems. Lord Fraser mentioned the great value an electronic mobility aid would have if it could operate without hampering existing mobility means.

^aCompanion of Honor.

He also said a reading aid allowing independent reading of the printed page by blind people would be an enormous contribution to their welfare. He thanked all the delegates, participants, and observers for coming, wished the Conference well, and expressed his hopes that it would be fruitful.

Dr. A. M. Uttley,^b Superintendent, Autonomics Division, National Physical Laboratory, then assumed his duties as Conference Chairman. He illustrated the magnitude of the information-acquisition problem of blind persons by pointing out that there is a 25:1 ratio of information-channel capacity for the eye to the ear, and for the sense of touch he drew a comparison of 625:6; a 625-line picture easily comprehended by the eye, compared to the six-line resolution a finger can achieve. After the Chairman's introductory remarks the formal papers of the Conference were presented.

Dr. A. M. Uttley also served as an individual session chairman for the two-paper session on Mobility As A General Problem. A summary of the Conference follows.

MOBILITY AS A GENERAL PROBLEM

(June 13, 1966)

CHAIRMAN: DR. A. M. UTTLEY
National Physical Laboratory, England

"Sensory Aids Evaluation: Procedures and Instrumentation"

J. K. DUPRESS, Massachusetts Institute of Technology, U.S.A.

Mr. Dupress said that an evaluation of a mobility aid should result in: 1. an estimate of the worth of the device in terms of its contribution to the mobility of blind people, 2. an addition to the body of scientific knowledge about the mobility of blind people, and 3. recommendations aimed at production of an improved version of the device.

Mr. Dupress also made several suggestions as to how an evaluation of a mobility aid should be carried out. He said the evaluation should be designed and conducted by a team of sensory or experimental psychologists, mobility rehabilitation specialists, and technologists. Appropriately chosen tasks, relating to real mobility needs of persons which are not satisfied by existing means, are the tasks the blind subjects should be asked to perform. There should be a thorough engineering analysis of the capabilities of the device. He continued that at present, the best approach is to consider the sensory aid under evaluation as a supplement to existing mobility means rather than a general solution to the mobility problems of

^bDr. Uttley is now Professor of Psychology, Sussex University.

blind people. Evaluation data should be gathered both under controlled laboratory conditions and in the field. Blind subjects likely to help discover the best features in a particular device should be used. Proper selection of the instrumentation to measure all the factors in the evaluation experiments is very important. Experimenters should have leeway to modify the device, particularly the section which displays the information for the blind user. It is quite essential in a task as complicated as blind mobility to allow adequate time for training. Mr. Dupress recommended that a new facility should be established to collect, process, and disseminate evaluation data. Improved evaluation procedures and better criteria for determining the worth of a mobility device are necessary.

**"Aids to Navigation, A Discussion of the Problem of Maps
for Blind Travelers"**

DR. J. A. LEONARD, University of Nottingham, England

Dr. J. A. Leonard spoke on the use by blind persons of specially prepared maps which extend their independent mobility capabilities by facilitating their discovery of new routes or their exploration of unfamiliar districts. He said maps are a symbolic and miniaturized presentation of reality. Sighted persons navigate through their environment utilizing information from the succession of landmarks they see (landmarks often appearing on their maps, too), and probably by using dead reckoning^a information in one form or another.

Because of difficulties with conceptualization of space by congenitally totally blind persons, there are problems when one simply presents them with tangible map replicas of a district. Dr. Leonard indicated that if the hallmark of visual perception is its simultaneous [parallel] characteristic, that of tactual and auditory perceptions is their sequential [serial] nature. Thus, spatial replica maps, embossed or made tangible by other means, and verbal "maps," in a way reminiscent of descriptive texts or guide books, may be used with varying degrees of success by blind people. Maps may relate only to a single route, or encompass a whole district or larger area. They may be portable for use while moving about, or they may be large for reference use at a fixed location. Numerous physical embodiments are of course possible for the verbal or spatial maps for use by the blind. Dr. Leonard is working with various encoding methods and simple mechanical means to improve the efficiency of the navigation information process with "maps" for use by the blind.

^aDead reckoning, a term of nautical origin, a corrupted form of deduced or ded. position, usually obtained from a record of the courses sailed and the time and speed (distance) along each.

SURVEYS — SOCIOCULTURAL, MOBILITY, AND READING

(June 13, 1966)

CHAIRMAN: HOWARD FREIBERGER
Veterans Administration, U.S.A.

"A Model for Society"

DR. M. D. GRAHAM and L. L. CLARK, American Foundation
for the Blind, U.S.A.

Dr. M. D. Graham and Mr. L. L. Clark spoke briefly of the extraordinarily wide variety of roles which have been filled by blind persons in the many cultures of the world, past and present. Similar variety is found in the attitudes of the sighted toward the blind. Details of a recently completed three-year study of 851 veterans of the United States Armed Forces were then presented. Mr. Clark said one fact stands out above all others about this group — this population of blind persons does not resemble any other population of blind persons studied so far. On the contrary, they resemble their sighted fellows quite closely. A higher-than-average marital separation rate for the group was explained by the speaker in terms of added strain on the wives of these blinded veterans. In addition to her usual duties, the wife must sometimes serve also as a guide for traveling, and as a reader. The authors concluded that the data from this recent survey suggest they can lay to rest the time-honored assumption that disability compensation necessarily destroys personal incentive. A look at the future with its increased automation and more leisure time suggests that all people, blind and sighted alike, could well follow the model set by the blinded veteran group in its current use of extra leisure time, time these veterans have because of their particular socioeconomic position in our society.

"A Survey of the Mobility and Reading Habits of the Registered Blind in England and Wales"

P. G. GRAY and JEAN TODD, Central Office of Information, England

The idea for this survey originated in the Applied Psychology Research Unit of the Medical Research Council with the thought that background information about blind people's habits and performance is an essential to conducting research into new aids in the fields of mobility and reading.

Mr. Gray, speaking about a preliminary report prepared for the Conference, said that from September to December 1965, 1044 registered blind persons aged 16-64 and 420 aged 65-79 were tested and interviewed by a trained corps of field workers using a scientifically designed questionnaire

comprising some 82 principal divisions. Careful attempts were made by the interviewers to elicit precise information about the past week's mobility activities of the persons interviewed. A 225-word passage in contracted braille, uncontracted braille, or Moon type was used in the reading test. Time was measured with stop watches and questions were asked to check on comprehension. It was indicated that in this preliminary report of the findings the concentration is on the information regarding a week's mobility and on measurements of the rate of reading for readers of embossed materials. Full results, touching on a number of other areas covered by the survey, will appear in a later more complete report.

In the preliminary report, data showed that well over half of the time spent traveling in a week was on foot, and about a third was on foot unguided.⁴ For the younger group, working, shopping, and walking each accounted for large amounts of time, and for the older group, shopping and walking were predominant. On the whole, blind men are more mobile than blind women. The proportion of blind people who go out on foot unguided steadily decreases with age, but increases with better sight. Dog guide users were found to go out for longer periods on foot unguided than other unguided blind people.

Some statistics abstracted from the preliminary report follow. Eleven percent of the 16-64 age group and 7 percent of the 65-79 age group claimed, when interviewed, normally to read some things in ordinary print. Approximately three quarters of the people interviewed have the newspaper read to them at least sometimes, about one quarter have magazines read to them at least sometimes, and about one tenth have books read to them. A sighted reader is thus frequently a source for newspaper material, but not so frequently for a book. About 23 percent have Talking Book machines. Forty percent of the 16-64's and 11 percent of the 65-79's said that they had become good enough to read braille. Reading speeds were measured by tests, and results for readers of contracted braille (some of whom did not complete the passage) are as follows:

Reading Speeds, Words per Minute		Persons
Less than 10		8
10 less than 20		26
20 " " 30		30
30 " " 40		29
40 " " 50		42
50 " " 60		19
60 " " 70		31
70 " " 80		21
80 " " 90		18
90 " " 100		13
100 " " 110		13

⁴Throughout the survey "unguided" meant without a sighted person.

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Reading Speeds, Words per Minute	Persons
110 " " 120	13
120 " " 130	9
130 " " 140	6
140 " " 150	13
150 " " 160	10
160 " " 170	6
170 " " 180	3
180 " " 190	5
190 " " 200	5
200 or more	7

[A total of 327 persons as shown in the table above read contracted braille. This accounts for 22.3 percent of the total sample. Only twenty-three persons, 1.6 percent of the total read uncontracted braille, and 37 or 2.5 percent read Moon. Of the sample, 1,027 persons or 73.6 percent did not even start one of the tests of reading with an embossed system. They probably do not read very much or very well by any of the touch systems mentioned.]

ECHOLOCATION — MAN AND ANIMALS

(June 13, 1966)

CHAIRMAN: PROF. R. W. MANN

Massachusetts Institute of Technology, U.S.A.

"Some Acoustical Differences Between Bats and Men"

F. A. WEBSTER, Sensory Systems Laboratory, U.S.A.

Mr. Webster pointed out that animal echolocation works well for the animal, hence like methods should apply to corresponding human requirements. The bat's echolocation system accomplishes several functions: short-range navigation, avoidance of discrete obstacles, configural evaluation of clear flying space available, detection and evaluation of targets, and echo utilization in the presence of interferences.

He stated that there are problems, of course, when one tries to apply the methods of animal echolocation to humans. When electronic echolocation equipments for use by the blind are coupled to the human auditory system, and the results compared with visual perception or with direct listening to active external sound sources, the received impressions seem to lack focus, clear spatial attributes, and external reality. Yet the bat's echolocation system gives clear evidence of a comprehensive, sharp, and meaningful coupling with the bat's external world. Mr. Webster said that one inference often made in this connection is that the channel capacity of the

human auditory system is too small, relative to the complex world of man, to provide a useful substitute for most of the important guidance features supplied by vision.

Mr. Webster indicated that, "To date, however, the basic inadequacy of the human auditory system is far from proved. While it is true that binocular vision supplies an immediate three-dimensional representation of great detail — after perceptual organization has taken place — it is equally true that a man's vision of a complex world is not directly 'given' by innate organization. In everyday situations, visual stimuli of limited bandwidth (or poor signal-to-noise ratios) are capable of triggering off perceptual entities that have been learned by extensive previous processes of perceptual organization. These entities may have a very large 'stimulus bandwidth' relative to the triggering stimulus. Thus the question of present concern might be put: If we were able to use the existing channel capacity of human audition for effective triggering of suitably organized acoustical entities, could audition substitute adequately for vision in normal mobility guidance?"

[A valuable bibliography of fifty-one items in this highly specialized area was included in the preprint version of Mr. Webster's paper.]

"Quantitative Measures of Unaided Echo Detection in the Blind: Auditory Echo Localization"

DR. C. E. RICE, Stanford Research Institute, U.S.A.

Dr. C. E. Rice spoke on a series of experiments conducted with two totally blind subjects, ages 25 and 32, who were blind five years or more, were experienced in echo-detection experiments, and were above average in intelligence. The experimental arrangement is shown in Figure 1. Adjustable aluminum arms (B) which hold the targets (C) extend out from and pivot on the vertical axis (A). Likewise, a center post (D) extends down and may be fastened to the subject's head by a head-holding device (E). The experimenter can read the azimuth angles for the subject's head and the target in use. The target was moved silently into place somewhere between ± 45 deg. from dead ahead. The subject was instructed to use his usual audible signal to find the target, and then to point his nose at it. Sounds such as tongue clicks and hisses were used. Precision of the location performance can be determined by reading and comparing the azimuth scales. Dr. Rice finds that subjects creating their own signal can obtain relatively accurate localization information. One factor which appears to play an important role in determining the precision of echolocation is the type and quantity of feedback information received by the subject concerning the accuracy of his responses.

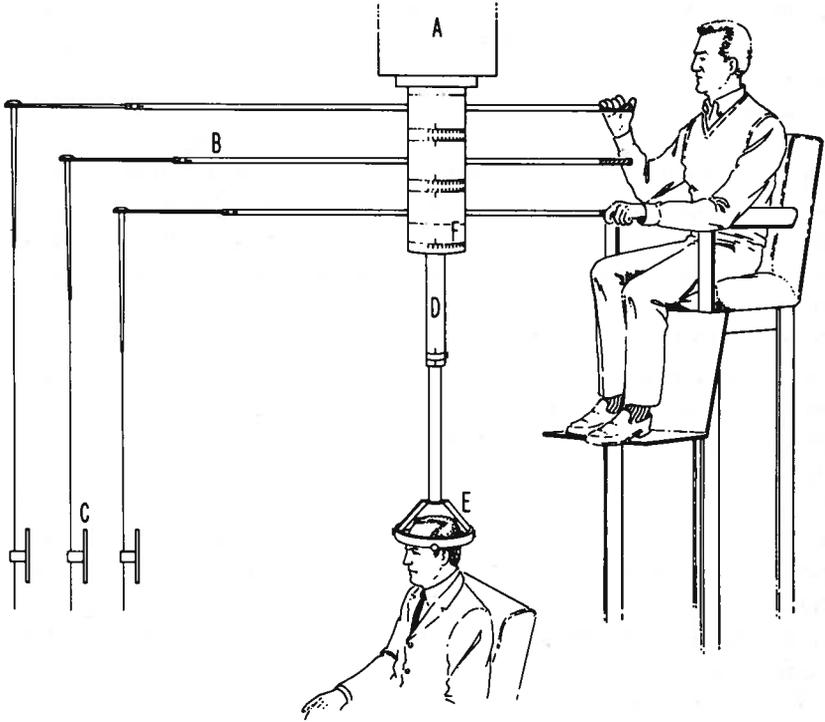


FIGURE 1

RECEPTION

Lord and Lady Fraser held a reception the evening of June 13, 1966, which provided an opportunity to speak briefly with them and which allowed an informal interchange between the participants and delegates.

MOBILITY, WITH SPECIAL REFERENCE TO REPORTS OF PRACTICAL TRIALS OF THE SONIC MONAURAL AID

(June 14, 1966)

CHAIRMAN: DR. M. D. GRAHAM
American Foundation for the Blind, U.S.A.

"Evaluating A Sonic Aid for Blind Guidance"

E. ELLIOTT, MRS. P. H. ELLIOTT, and D. ROSKILLY, St. Dunstan's
Research Unit, England

Mr. E. Elliott presented this two-part report. He stated that safe and efficient mobility requires one to have capabilities in three areas: obstacle

avoidance, navigation, and orientation. Mr. Elliott considered each of these items, both in reference to the mobility of the sighted, and that of blind persons using the sonic aid. He then discussed specific properties of the sonic aid developed by Professor L. Kay and built by Ultra Electronics, Ltd. Characteristics of the echoes, and ways of using the aid were then explained. One can point the aid high to give minimum ground return, or one can scan to detect holes and low objects. Mr. Elliott indicated the aid should not be moved too rapidly. A scan pattern tied in with the foot movements of the user was advocated. Some insight into the training procedures for use with the aid were also included. In discussing the preliminary phases of training Mr. Elliott set up the following series of activities: 1. handling the aid, 2. holding the aid, 3. learning some elementary notions of the pitch-distance relationships, 4. doing progressively difficult lessons in pitch frequency relationships involving multiple reflectors and extended reflectors, 5. practicing the assessment of the distance of reflectors while walking with the aid, 6. gaining some appreciation of the conical features of the sonic beam, 7. practicing finding the way through narrow gaps, 8. learning to keep at a constant distance from a shore line, 9. learning to scan in time with foot movements, 10. learning the sounds produced by reflections from different surfaces, and 11. learning some of the elementary ideas on strategies for street work using the aids.

In attempting to answer the question as to whether the sonic aid is useful, Mr. Elliott felt that reliance on user opinion alone is likely to be a most unsatisfactory yardstick. He said that the view he should like to urge is that initial success for the aid would be shown if any of the three mobility requirements was satisfactorily met. The aim of his present work is to gather information which will help to answer the following questions: 1. Does the aid, after suitable training, enable a man to avoid obstacles reliably? What are the costs for doing this and what facilities might be needed for routine training? 2. Does the aid, after suitable training, enable a man to navigate reliably? What are the costs and requirements for routine training? 3. Does the aid enable a man to orient himself accurately? What are the costs and routine training requirements? 4. What are the effects of considering the use of the sonic aids in conjunction with other devices (cane or dog guide)? 5. Are there any immediate modifications of the aids which would make them more effective or more convenient?

The second report prepared and presented by Mr. Elliott and his colleagues included information on selection of subjects, training facilities for different groups, preliminary training (getting to know the aid), street work, and the outlook for the future. In appendices to the second report, he provided a questionnaire aimed at getting information about mobility

of blind persons, and listed defects found in current models of the Kay-Ultra aid and the effect of noise on performance with the aid.

Three groups of subjects participated in Elliott's research. The first group was at the National Physical Laboratory, the second was called the Heatherset group, and the third the Holland Park group. At National Physical Laboratory a training device called "Stonehenge" was constructed using 1-in. diameter metal poles which gave good echoes, placed haphazardly around the perimeter of a circle of five foot radius. The subject under instruction sat in the center of this ring of poles and by shuffling his feet to make sounds would gain knowledge of the existence of the poles. Then by use of the aid he could make comparisons between the two echolocation methods. Other training devices were also used including magnetic tape recordings of the sounds of the device. The chord-like sounds coming from reflectors at varying ranges were also introduced to the subjects as well as the variable sounds coming from different surfaces. Tape recordings of sounds from a number of surfaces were made for training purposes. Some of these were a close-clipped hedge, a brick wall, a metal railing, and corrugated iron fencing. After approximately 12 hours of training with the special training devices and the tape recordings, the subjects, though far from skillful in the use of the aid, were allowed to try it in the street.

In commenting on the outlook for the future, Mr. Elliott said that detection of low obstacles may be inherently too difficult to make the aid acceptable as a complete substitute for a cane. He said further that the complex of skills necessary to learn to use the aid is substantial, and that the costs of routine training in use of the aid will be quite large.

"Evaluation of the Ultra Electronics Sonic Mobility Aid in Kentucky"

T. V. CRANMER, Bureau of Rehabilitation Services, U.S.A.

The first shipment of ultrasonic travel aids was received in Kentucky in March 1965. Considerable planning had preceded receipt of the units. Some of the questions the Kentucky group desired to answer about the aid were as follows: Is the ultrasonic aid any good? Does it have significance from a rehabilitation point of view? Will it give a blind person information to which he does not now have direct access? Is it truly an aid, supplementing other channels of information? Can we expect it to be a worthwhile contribution to mobility for a significant number of blind people? Is the student's investment of time and effort to learn the "language" of the aid adequately rewarded by meaningful information?

From a field of 75 persons, 35 actually were introduced to the instrument and given orientation and a brief survey of the total training program. From this number a total student population of 17 was selected for

final training. The users of the aid in Kentucky had comments to make, both pro and con. They enjoyed the freedom from fear of tripping others or collision, the ability to move quickly, the lack of conspicuousness, and the light weight and small size of the aid. They were concerned with a need for a fairly involved learning experience, the use of an external battery instead of one inside the torch, and the lack of a more positive indication of a single stepdown.

Mr. Cranmer concluded that he and his staff consider the ultrasonic travel aid for the blind an important contribution in the areas of mobility and orientation. They are looking forward to the production of an improved ultrasonic aid with its power supply housed inside the torch. He also stated he hoped to see the development of appropriate training programs for use by rehabilitation centers, by home teachers, and by those blind people who would like to undertake study of the device at home.

**"A Training and Evaluation Program for the Kay-Ultra Mobility Device"
(conducted at the American Center for Research in Blindness and Rehabilitation^e)**

DR. L. H. RILEY, St. Paul's Rehabilitation Center, U.S.A.

Dr. Riley discussed the rationale for laboratory testing and field testing with the Kay-Ultra aid against the background of the requirements for careful assessment procedures. Some of the information requirements for any mobility device were examined, and the Kay-Ultra aid was discussed in this context. The research objectives of the study were examined in the light of background variables and training evaluation procedures.

Mentioning some of the details of the study, Dr. Riley said 14 trainees completed a 20-week training and evaluation program with the aid. Skill parameters were determined and training procedures were designed around these skills. Evaluation followed closely the training procedures in almost all the cases. Evaluation included obstacle course performances before and after training with the mobility aid, and specific skills such as ranging and locating objects. Outdoor work emphasized navigational skills, and the evaluation was based on mobility-course testing using "harm-events" and time of transit as measures of skill. He indicated that background data including age, IQ, hearing and vision, age at onset of blindness, previous education, hours spent in training, trainee favorability toward training, anxiety, concentration, and personality testing were taken on all subjects and that these measures were related to performance. Data from this study indicate that the major performance composites related highly to each

^eThe report on this project made to the sponsor, the Veterans Administration, appears elsewhere in this issue.

other and to the personality scale composite scores. It is suggested that "defensive inflexibility" was one of the most important correlates of mobility aid learning. The data strongly suggest that certain personality dimensions, cognitive factors, and hearing abilities such as pitch discrimination, compose a syndrome which is extremely relevant to the acquisition of skills involved in using an ultrasonic aid.

Dr. Riley pointed out that many difficulties in use of the Kay-Ultra device for navigational purposes could not be approached directly in this study. Subjects' reports suggested certain training recommendations for full field research with the Kay-Ultra device. Promising results were predicted provided certain trainee selection and training methods are established.

"Summary of Additional Sonic Aid Evaluations"

DR. A. CARPENTER, Medical Research Council, England

Dr. Carpenter received reports from all over the world concerning the Kay-Ultra aid, and some highlights will be mentioned here by way of summary. From the Royal New South Wales Institution for Deaf and Blind Children at Sydney, New South Wales, Australia, comes the thought that the aid was presented as one type of mobility help, together with the cane and dog. It is accepted as a definite help in developing orientation. From the Ligue Braille, Brussels, Belgium, comes the comment, "It is a very expensive toy, which could certainly not hope to take the place of an ordinary stick." From Hannover, Germany, some difficulty was reported in holding and positioning the aid and in coordinating torch movements. The sound itself was disliked. After three months of training, two other subjects at Hannover still preferred to go out without the aid, but to use it for exploration only. A conclusion from Reykjavik, Iceland, included the following: the aid is highly recommended, but only for suitable and highly selected people. At Oslo, Norway, the aid is considered to be useful in detecting stationary objects but not for moving vehicles or people. The subject at Zurich, Switzerland, clearly likes his aid and would like to keep it if the cost were not too high. He notes the difficulty of detecting step-downs. An 18-year-old from Cincinnati, Ohio, U.S.A. finds the main value in the aid is in helping him to "keep in contact with reality" and in providing "bonus information" about his environment. The only real disadvantage noted is that the aid does not label him as blind, as does a white stick; a matter which may sometimes be important. In a letter from Sacramento, California, a man considers the aid to be a most useful device, but only for some people, and after much training. He, himself, prefers to use the cane. It was concluded at San Diego State College, San Diego, California, U.S.A., that the device has a tremendous potentiality and that future

research should concentrate on making the information provided by the device more readily employable by the blind user. A 17-year-old from the Colorado School for the Deaf and Blind, Colorado Springs, Colorado, U.S.A. claims good mobility with a long cane, yet would now prefer the aid if he had to make a choice. The preceding notes are based on returns to a questionnaire referring to 17 aids in the field throughout the world. A tally of these 17 shows that 2 were disliked, 6 were liked only with reservation, and 9 were unreservedly liked by the persons reporting. Dr. Carpenter concludes first that there is room for mechanical improvement in the aid, especially in the battery supply, the type and fitting of the earphone, the storage of wires, etc. Second, the training has to be right for the individual subject, and thirdly, the subjects must be selected. Certainly by no means all blind people can be taught to understand the information produced by the aid in its present form.

PSYCHOLOGICAL ASPECTS OF MOBILITY GUIDANCE DISPLAYS

(June 14, 1966)

CHAIRMAN: PROF. R. L. BEURLE
University of Nottingham, England

"Vestibular Guidance"

DR. I. KOHLER, University of Innsbruck, Austria

Dr. Kohler developed some facts on the galvanic stimulation of the vestibular organ and pointed out the possible relationships of this effect to the design of mobility aids for the blind. [There is a possibility that the strong reaction of the person to such stimulation may be useful in feeding directional information derived from some instrument into the human being.]

At the conclusion of the afternoon session, Dr. Kohler gave a demonstration of vestibular stimulation in the hotel foyer. Even though this showing was slightly marred by small technical difficulties often associated with such impromptu demonstrations, it nevertheless displayed very forcefully the strong effect on balance of electrical currents passed through the vestibular process. Using pocket-sized portable radio receivers and wire transmitting antennas draped around the floor of the demonstration room, Dr. Kohler was able to transmit vestibular stimulation control information from a fixed central location to a subject walking in the room. He could control the veering or stumbling of the subject to the left or to the right depending upon the direction of the current he caused to be passed through the vestibular process of the walking person. Professor R. H. Gibson was kind enough to serve as "the guinea pig" for these very striking demonstrations.

"Tactile Stimulation"

PROF. R. H. GIBSON, University of Pittsburgh, U.S.A.

[Electrical stimulation of the skin has been studied noting particularly the effects of four major variables: pulse repetition rate, stimulus duration, electrode size, and bodily location. Electrical properties of tissue were also investigated using pulses of direct current. It was found that increases both in temperature and in current reduce tissue resistance.]

"Tactile System Giving Indication of the Distance of Obstacles for Blind Guidance"

A. CHAVANON, Valentin Haüy Association for the Welfare of the Blind, France, and PROF. M. BUYLE-BODIN, National Higher School of Electronics, France

Mr. Chavanon and Professor Buyle-Bodin told of some of their preliminary and general researches concerning an obstacle detector for the blind built into a cane and having a tactile output. Desiring to keep the normal auditory channels and the sensory channels of the facial skin unencumbered, these researchers decided on a cane configuration with tactile stimulators to give information on the range of the distant obstacle. Three stimulators cooperating with three fingers in a variety of suggested codes are proposed as the ranging signal device. A drawing of the cane contemplated by these workers shows that it will use ultrasonic energy as the means for probing into the distance ahead.

**REPORTS ON SENSORY RESEARCHES IN THE NETHERLANDS
AND CANADA
(June 14, 1966)**

CHAIRMAN: PROF. R. L. BEURLE
University of Nottingham, England

"Researches in the Netherlands"

PROF. R. G. BOITEN, Technische Hogeschool, Delft, Netherlands

Professor Boiten emphasized the importance, in certain experimental observations with human beings, of conducting the experiment in such a way that the human subject is not aware that an experiment is being conducted. He gave a few ingenious examples of the means by which such experimental procedures may be achieved. In one instance he described experimental work on balance in riding a bicycle and pointed out how he was able to introduce a slight perturbation in the vertical position of the

cycle and then observe how the rider corrected for this, the rider himself being unconscious that a small deviation had been introduced.

"Research on Mobility Aids for the Blind"

J. C. SWAIL, National Research Council, Canada

Mr. Swail spoke on four general topics: 1. evaluation of the Kay-Ultra ultrasonic aid, 2. design of a folding typhlocane, 3. research on an orientation aid, and 4. development and use of sound beacons. In summing up his impression on the ultrasonic aid, Mr. Swail said "The sonic aid is not likely to solve the mobility problems of all blind people willing to travel on their own, any more than the dog or cane have done. However, it does offer some unique possibilities and opportunities for those willing and able to learn to use it. It seems likely that if the most is to be made of the potential of this device, some form of organized program and training centers must be set up to perform this function, just as has been done with the dog guide and lately with the Hoover Cane." Mr. Swail then described his five section typhlocane with Neg'ator springs in the handle used in the tensioning system. Specially ground and precision finished conical-shaped joints between the several sections of this cane provide for self-seating and maintenance of rigidity even though wear occurs. The orientation aid mentioned by Mr. Swail refers to his modification of an ordinary small pocket-sized transistor radio. Using the fairly uniform direction of the radio field in any particular small local area as a reference, this aid with a specially adapted audio output enables a person to maintain a path along a straight line relative to this field. The device is meant to be used to enable a person to maintain a straight line of travel where other cues are lacking, also possibly as a training aid for blind mobility learners, and also as a device to give an indication as to how much people veer when they think they are walking a straight line.

Mr. Swail also spoke about two general types of sound beacons he had developed. The first type emits a short audible pulse repeated at intervals, the second responds with an audible pulse to a signal produced by the blind traveler. The repetitive sound beacons are small battery-operated transistorized self-contained units. They produce 1000 Hz square wave pulses one quarter of a second in duration repeated every 10 to 14 seconds. These units are useful to blind persons in several situations; for example, they may desire to return to the same spot on shore after swimming alone, or they may wish to maintain orientation while shoveling snow or cutting grass, or they may want to return to an object that must be left for a few moments. The transponding sound beacon contains a microphone, high gain selective amplifier, and trigger circuit to control an audio oscillator which in turn drives a loud speaker. It is actuated by the sounding of an

ultrasonic dog-whistle to which it responds with a single burst of tone. A use envisioned for this device is to mark the entrance in a large housing establishment or similar complex where adequate landmarks are lacking.

NATIONAL PHYSICAL LABORATORY

(June 15, 1966)

Wednesday, June 15, was devoted chiefly to a visit to the National Physical Laboratory at Teddington near London. Dr. A. M. Uttley, our Conference Chairman and also superintendent of NPL's Autonomics Division, welcomed the group and briefed us on sensory aids projects being undertaken at the Laboratory. We first visited the St. Dunstan's project dealing with output sounds for reading machines for the blind. Samples of outputs of the multi-dimensional optophone, PAT (parametric artificial talker), wuhzi,^f etc. were played. One new variant, tried only briefly, involves projecting letter images onto, in effect, the output of a speech spectrogram device, and then creating the sound which would produce such a displayed letter. If one subsequently makes a speech spectrogram analysis of these sounds, readable letter characters result showing that the letter information is present in the sounds. These sounds were not unpleasant.

Our second stop at NPL was in the laboratory of Anthony D. J. Robertson, a neuro-physiologist probing the visual cortex of the cat to study individual neuronal activity in response to visual stimulation. The third stop was to see CYCLOPS, an automatic digit-recognizing machine. This device electronically scans the printed digits, effectively displays them on a television raster-swept screen, and then by slight deflections to the right or left, and up or down, successively applied, with negative and positive image forms, the numeral images are compared with the series of displaced images of the same character. For a given program of displacements, usually one and only one figure will allow light to pass somewhere through the "layered" displaced images, thus effecting recognition. [The system is insensitive to misalignments and character tilt, but may not do so well on multiple fonts.]

After luncheon, we all proceeded to an outdoor course which had an ordinary parking-lot fence at one side of the demonstration route, and a specially erected rail fence at the other. The Kay-Ultra aid was demonstrated here by Mr. and Mrs. E. Elliott and their assistants. Two adults traversed the roughly quadrangular course, followed by several youngsters with less training, all using the aid alone. Later the subjects traversed the

^fWuhzi is a synthetic pronounceable language developed at Haskins Laboratories and based on a transliteration enciphering of written English which preserves the phonetic patterns of the words.

course, but using their normal means of mobility. Lastly, the course was fitted with some obstacles, and the subjects again traversed it using the Kay-Ultra device alone. While all traversed the course in each case safely and completely, there were comments from some visiting participants that the performances, both with the aid, and with their normal mobility means, could be improved with further mobility training. Dr. Riley noted that the left arm of sonic-aid users scanning with their right hand hung rigidly at their sides, *not* swinging in contramotion to their leg. He said this was a sign of considerable nervous tension, that in relaxed persons the swing is unconscious, but here in a tense person the swing process is blocked.

WORKSHOP ON MOBILITY

(June 15, 1966)

Dr. M. Clowes organized and held a workshop session on mobility during the early evening of June 15th at which Professor Mann, Dr. Carpenter, and Dr. Leonard were the principal discussants. Professor Mann told how difficult the problem was, that its complete solution could take decades, that we know little now about processing and display of sensed information, and that he aims for nothing less than independent mobility of a blind person under nearly all conditions and at a performance level almost as good as that of the sighted person. Dr. Carpenter tried for a "brass tacks" approach with some suggestions vis-a-vis further work in the Kay-Ultra program. Dr. Leonard was somewhat in disagreement with both, saying much more cane and dog travel should interest the British first, then studies of mobility requisites, and then finally perhaps more on mechanical aids.

MOBILITY AIDS — CURRENT RESEARCHES ON SONIC AND OPTICAL SYSTEMS

(June 16, 1966)

CHAIRMAN: DR. I. C. WHITFIELD
The University of Birmingham, England

"The Bionic Instruments Travel Aid"

PROF. T. A. BENHAM, Haverford College, U.S.A.

Professor Benham first made some introductory remarks of a general and historical nature describing briefly work in electronic mobility aids for the blind which had been done since World War II. In describing his own work at Bionic Instruments, Inc. and Haverford College, he set down 10 guide-posts which were used in determining the design philosophy at these

establishments: 1. Provide separate obstacle, curb, and overhead-projection detectors which are normally quiet, i.e., they deliver no signal until needed, and which are not accidentally actuated by irregular movements of the instrument occurring during walking. 2. Supply three-channel signal presentations through tactile stimulators: one for curbs at a distance of 3 ft. to 7 ft., one for obstacles 0 ft. to 10 ft. away, and the third for overhead projections less than 1 ft. above head level. 3. Have automatic scanning. (Manual scanning has been retained to date because of the complexity added by automatic scanning techniques.) 4. Maintain extreme simplicity in initiating operation. (The user would prefer simply to pick up the device and be ready to travel.) 5. Include a feature to aid the user in walking a straight line. (How this may be done is not known. It is listed simply to encourage thought on the subject.) 6. Have no moving parts except tactile stimulators. 7. Provide a variable-range control for obstacle detection. 8. Be technically foolproof; that is, it should not be affected by light sources other than its own and should be "fail-safe." 9. Weigh less than a pound, be easily carried when not in use, and have a battery life of at least 2 hours before recharging is required. 10. Be available in progressively more complex models to accommodate users of varying degrees of ability.

Professor Benham then went on to give some technical details of the Model G-5 Obstacle Detector which has already been built in a quantity of 15 units at Bionic Instruments, Inc. Informal field tests have been conducted using this device and some results are as follows: The long distance range (9 ft. to 50 ft.) was found to be of very little value. Most users expressed a desire for a dual-range instrument, though there was some indication that a single-range device would be acceptable, especially if there were compensations in size and simplicity. Many users stressed preference for a cane-device, since the cane calls attention to their blindness, gives them physical contact with their environment and warns them of curbs and other small discontinuities. Several reported they used the device to explore the surrounding environment: foliage on trees, bare limbs, and holes. One subject was relieved at being able to find his empty garbage cans without wandering up and down the street in a conspicuous manner looking for them. One user experienced difficulty with the G-5 in the subway, another reported finding train doors and an empty seat without problems. Almost all found the G-5 cumbersome and asked for either a smaller device which would fit in purse or pocket or for a cane with obstacle detector built in. Two subjects suggested that automatic scanning would help. Nine of the 14 cooperating in these informal field tests made statements of definite approval of the device, indicating that they would like to keep the instrument which they had or that they would purchase and use a smaller, modified version of it if it were available at reasonable cost.

Professor Benham then described some of the current and future developmental work being carried out at Bionic Instruments, Inc. and Haverford College. Because of the strong preference for a cane configuration expressed by the blind subjects and by many experimenters in the field, it was decided to put as many desirable features as possible into a cane-like device. In addition to the capabilities of the model G-5 (forward obstacle detection), this device will incorporate both a detector for major discontinuities in terrain, such as holes, flights of stairs, platform edges, and a detector for overhead projections. The cane device will have a nacelle containing the optics. Small tube-like structures will house the three gallium arsenide lasers, one for each of three functions: overhead detection, forward detection, and hole detection. The nacelle will house the three sets of receiving optics and diodes. The overhead-projection receiver is sharply focused on a space between 5 and 7 ft. above the ground at a distance of about 5 ft. in front of the user. If there is an obstacle in this space, it is illuminated by the upward-looking laser and returns a signal to the receiver, which then operates the stimulator. Great care has been taken to maintain in the new cane the balance and handling dynamics of the "long cane" so that blind people used to a cane will require minimum adjustment for using the electronic version. It is anticipated that, unless the laser under discussion falls far below the performance expected of it, the cane device will be ready for manufacture in small quantities for field testing in 1967. While routinely reliable curb detection with a practical device has not been achievable to date, it seems advisable to continue to pursue the problem in the hope that advances in the state of the art and improvements in techniques will ultimately lead to a useful electronic curb detector.

"Ultrasonic Spectacles for the Blind"

PROF. L. KAY, University of Canterbury, New Zealand

Professor Kay commenced with a historical introduction in which he traced his thinking and philosophy about ultrasonic mobility aids from the conception of the idea to the present embodiment in the torch constructed by Ultra Electronics, Ltd. Professor Kay then discussed the value of auditory cues in mobility and showed how the auditory output of the sonic aid for the blind can assist. He then went on to describe the binaural form of the sonic aid which uses the same principle as the monaural form but has a wide-angle transmitter and two wide-angle receivers spaced apart a distance approximately the same as the spacing of the ear. One receiver has its output coupled to the left ear and the other to the right ear. Signals arriving from an object directly ahead reach both receiving transducers simultaneously and, for an ideal reflector re-radiating the wave energy equally toward each receiver, the outputs from the two channels are identi-

cal in all respects. The time of arrival, the pitch of the audible note, and the amplitude modulation as well as the phase are the same. An object to the right side of the ahead position is further away from the left receiver than from the right. The time required for a reflected signal to reach the left receiver is therefore slightly greater than the time to reach the right receiver. There is therefore a time difference between the two audible outputs, and because the spacing of the receiver is similar to that of the ears, this time difference is similar to that experienced when listening to natural audible sounds. Further analysis of the system shows that there are four directional cues: 1. time difference of arrival, 2. frequency difference, 3. amplitude difference, and 4. amplitude modulation. Complex object situations produce highly complex signal patterns. These contain the same basic distance and direction data as for the single ideal reflector, but elaborated in terms of combination of the effects of each reflecting element in the spatial pattern. A pattern transformation thus takes place and the neural system is required to effect a second transform from the auditory pattern back to the spatial pattern in order that appreciation of the environment may be possible. Subjective tests of a limited nature have been carried out to assess the capability of the man-machine system. The conclusion drawn from these tests was that amplitude difference was a dominating cue to direction, but quite clearly a fairly exhaustive study was required to elaborate on these preliminary results. There have been favorable responses on the part of three blind people who have tried the binaural spectacles, and five critical sighted observers introduced to the torch and the spectacles for the first time instinctively felt that appreciation of the spectacles was more rapid. Professor Kay concluded by emphasizing that he feels the primary factor now is a greater appreciation of one's surroundings. A cane user or a person using the dog guide could benefit from sonic aid information because such data would be additional to that normally used. Persons could benefit as their immediate-environment-sensing-capability is improved.

"Travel-Path Sounder — Further Results"

L. RUSSELL, Cambridge, Massachusetts, U.S.A.

Mr. Russell told of a small mobility aid about the size of a portable camera or small portable radio. This unit is hung on a leather strap from the neck of the blind user. The device probes out into the space ahead of the user with ultrasonic pulses. Reflected ultrasonic energy returned from an object in the zone being insonified by the device is received by the unit which then processes this information and produces its output. The output has been deliberately made quite simple and is in the form of auditory signals emanating from a small loud speaker built into the unit. This output can be controlled so as not to interfere with ordinary perception of the

ambient sounds. The simplified output coding is such that when an object enters the active zone about 6 ft. away, a clicking sound is heard in the loud speaker; otherwise it is silent. As the object gets closer to the device the loudness of the clicking sound increases. This was considered to be analogous to most normal amplitude-distance phenomena and should not be too difficult to appreciate. A second, more strident warning signal occurs when the user is but 30 in. from the object. Here a beeping tone is introduced. Thus, all sorts of information relative to shapes, textures, and identities of the object items spaced in front of the user have been stripped away, leaving him only with the simplest information that there is something in the way and with a rough indication of its placement. [Such a system seems to have the advantage that it does not encumber the user's ordinary mobility cues to any great extent and allows him to move about without thinking particularly about the electronic mobility aid he is wearing. The aid however does definitely provide useful information not always obtained through other means.]

"An Optical-To-Tactile Image Converter"

K. W. GARDINER, Stanford Research Institute, U.S.A.

Mr. Gardiner told of his work at Stanford Research Institute with Dr. Bliss and of the construction of an 8 by 12 array of 96 air jets which was used in tactile studies in a variety of projects. Some of the matters studied were as follows: spatial acuity, frequency effects, tactile illusions including apparent location and apparent motion, effect of display movement on tactile pattern perception, tactile perception of sequentially presented spatial patterns, exploratory experiments on spatial interaction, information available in brief tactile presentations, reaction time experiments, and tactile displays for tracking. The air jet array was also used to present computer generated letters for tactile reading by a blind person. Encouraging results were obtained.

Dr. Linvill is interested in producing a reading device for the blind using piezoelectric bimorph stimulators in an array similar to the 96-element array. He has constructed a piezoelectric-bimorph-array controlled by the computer to generate tactile letters for reading by a blind person. This unit also was relatively successful and with practice a subject was able to read at a speed of 30 words per minute.

Mr. Gardiner said he believes that these results clearly establish the psychological and technological feasibility of a multi-element tactile array of bimorphs with capability of transmitting relatively complex rapidly changing patterns to a person. Extending these ideas to an optical-to-tactile image converter Mr. Gardiner described a hand-held optical input device

which a user could aim at the environment thereby acquiring information for conversion to a tactile representation of said environment on the 96-bimorph array. A motion picture was shown of a person using this device, probing the environment, and receiving information from the tactile array by touching with his hand. Mr. Gardiner concluded with an optimistic view that significant visual prostheses are possible and that optical-to-tactile image conversion could be a solution, although considerable technical problems yet remain to be solved. It was also found that the 96-point array in combination with the optical system used did not provide an overabundance of information for the subject's tactual system. Rather, limitation seemed to be with the equipment and Mr. Gardiner felt that subjects could make good use of tactile arrays with considerably more than 100 stimulators. He concluded by reminding the group that complex patterns of communication by language take years to develop. He feels that commensurate effort with tactile communication may lead to greater successes than have ever been achieved before.

READING AIDS

(June 16, 1966)

CHAIRMAN: DR. D. E. BROADBENT

Medical Research Council, Cambridge, England

"High Performance Reading Machines for the Blind: Psychological Problems, Technological Problems, and Status"

DR. M. STUDDERT-KENNEDY and DR. FRANKLIN S. COOPER, Haskins Laboratories, U.S.A.

Drs. M. Studdert-Kennedy and F. S. Cooper said that of the acoustic displays currently available for a reading machine for the blind, there is little question that the most efficient is speech. They pointed out that normal speech may be comfortably followed at a rate of more than 200 words a minute. This means that the listener is handling 40 to 50 bits of information a second. This corresponds to a rate which is an order of magnitude higher than listeners have achieved with any non-speech code so far developed. There seem to be two main reasons for this. First, speech signals are multi-dimensional, but the dimensions are not arbitrary. Rather they are determined by characteristics of the articulatory apparatus that people use to generate speech. Secondly, speech signals, unlike certain other auditory coded representations, form a complex pattern of overlapping cues in time, a flowing auditory display in which some elements are provided to the listener in parallel rather than in series. In applying these principles to

the selection of an output for a reading machine, the speakers pointed out that there are three possible types of devices which may be developed: 1. a simple machine with a non-speech output, 2. a fairly simple machine with a speech-like output, and 3. a more complex machine that really generates speech. Citing a number of non-speech machines that have been studied over the years the authors pointed out that in the end the performance was still poor, less than two bits per second even with the more successful displays. They said speech-like output devices may seem more promising. However, there is a trade-off involved between the complexity of the circuits necessary to produce a speech-like signal notably better than the non-speech signal and a full recognition device with far better output. Furthermore, there is a strong presumption that the speech-like patterns generated must also be pronounceable in order that subjects can learn quickly to appreciate them. Results of work with speech-like outputs show that subjects do in fact have better performance than with non-speech encodings, but far short of the performance achievable with speech itself. It seems to the speakers that the only known acoustic signal adequate to coding of written text for easy and rapid assimilation is speech.

The speakers then turned to the means of generating such speech by machine. Three varieties of machine-generated speech were mentioned: synthetic speech, compiled speech, and re-formed speech. Speech spectrogram analyses of speech led to rules by which a computer could be programmed to re-create speech if it were fed with a phonemic transcription of the material involved. For use in a reading machine for the blind, however, such a system involves a good character recognition "front end," and the ability somewhere to translate from the sequence of letters recognized (a graphemic representation) to a series of pronunciation codes or a phonemic representation. Having a phonemic transcription, it is not too difficult to program a computer to produce reasonable synthetic speech.

Compiled speech is a rather obvious way to get speech output for a reading machine for the blind and involves the hooking together of pre-recorded individual word utterances in the desired new sequence of words. Much of the difficulty of this method hinges around the fact that there are different pronunciations for the same word depending on context, meaning, inflexion, emotional factors, etc. Another difficulty is that it would be almost impossible to record every single word that may ever come up. Thus, the alternative means of spelling out the missing words in a spelled-speech form of presentation was evolved. These spelled words make the system much more difficult to use than one might at first imagine, particularly if the reading speed is high and the words requiring spelling are, as is quite likely, the more unusual ones.

Re-formed speech, the third variety described by the speakers, is a hybrid form which requires a compilation of control signals on a word-by-

word basis and then use of these signals to operate a speech synthesizer. Economy of storage can be achieved this way because good speech can be generated from about 2400 bits per second for the control signals as compared with 48,000 bits per second or more for the digital storage of speech wave forms. The synthesized words can be modified later in terms of syntactical information which can be derived from the sentence structure. As more is learned about how to infer the syntactic structure of sentences and to use this information as a person does, the machine may be made to produce even more life-like speech. The equipment requirements for this means of speech production are quite formidable.

Dr. Studdert-Kennedy also attempted an analysis of the costs of the various systems of reading for the blind that have been proposed. In an appendix to their printed paper the speakers estimate the costs of generating speech in dollars per hour for several means. By way of concluding summary they indicated that their research to this point has led them to put aside the method of synthesis by rule, and to concentrate on generating and testing user acceptability of compiled speech as an immediate objective while at the same time they work out the remaining problems of generating re-formed speech. They indicated that the present prospect is that re-formed speech will be the method of choice.

"Progress and Problems in the Design of a Reading Aid for the Blind"

DR. M. B. CLOWES, Commonwealth Scientific and Industrial Research Organization, Australia

Dr. Clowes mentioned the research program sponsored by St. Dunstan's at the National Physical Laboratory where means to improve reading performance attainable with the optophone are being sought. Some findings of the work carried out at NPL under the St. Dunstan's program included the demonstration that if the audible dimensions of the code were increased, reading accuracy would be improved. Also, if the symbol classes could be reduced in number, there is demonstrated improvement in capability. The traditional optophone gives a fairly lengthy and complicated tone pattern for each particular letter. Information theory predicts that if the encoding process were such that the tones corresponded to particular letter features or even to whole letters, the performance would be improved over the present condition where the tones are responsive to smaller elements in the letter shape. Dr. Clowes pointed out that great improvements along these lines will occur only when we more thoroughly understand the processes underlying the perception of form. He said that the long-term approach to the design of a reading aid could proceed via the development of fundamental theories and models of perceptual processes based upon the concept of a grammar. Such grammars, having universal content not restricted

only to describing the structure of speech, may even have advantages in other areas of sensory aids research, for example in the design of effective displays for mobility aids.

"The Development of Recognition and Direct Translation Reading Machines for the Blind"

G. C. SMITH, Mauch Laboratories, U.S.A.

The most advanced personal reading machine described by Mr. Smith provides the blind user with a spelled-speech equivalent for each upper- and lower-case letter or ligature scanned by a hand-held optical probe. The $\frac{7}{8}$ -in.-diameter optical probe contains a 13 mm. focal length $f:1.9$ lens and an array of photo cells. The lens and array are positioned by special cams which permit easy adjustment of the magnification to any value between one and five. The character recognition machine has been tested on nine fonts to date and recognizes letters with moderate accuracy (90 to 95 percent) and speed (80 to 90 words per minute) by using a special arrangement of 12 cadmium selenide photoconductive cells to gather information on letter features. Several "looks" in what Mr. Smith called a "snapshot" process are taken of each letter as it passes over the recognition array. The combined information from the several looks at each letter is decoded in a decoding matrix which effects the identification of the letter. Having been identified, the letter information then goes to the word synthesizer, a device which produces words in spelled-speech. The development of the hand-held probe for this device has resulted in a family of aural and tactile output direct translation reading aids which are pocket-sized and battery-operated and may be used independently for low speed reading. Mr. Smith described a mechanical tracking aid which has been produced to serve the several optical probe devices. He pointed out that one or more of each type of these devices has already been built and tested.

"A Direct Translation Reading Aid"

PROF. J. G. LINVILL and DR. J. C. BLISS, Stanford University and Stanford Research Institute, U.S.A.

Mr. K. W. Gardiner presented the paper for the authors who were not present. The aim of the research has been to investigate the psychological and engineering factors involved in making printed material directly usable by blind people. The mechanism of such reading would be by direct optical to tactile translation wherein a replica of the printed letters on the page would be presented to the user by some device in terms of a tangible facsimile. A computer was programed to move the letters across a 12 by 8 array of tactile stimulators somewhat reminiscent of certain electric light news display signs. After 17 hours of training, three subjects were able to

read at 20 words per minute. Two of the subjects were able to read at about 30 words per minute after 50 hours of training. The engineering aspects of such a reading aid were also discussed by Mr. Gardiner. The paper's authors said piezoelectric reeds of lead zirconate are simple motors which translate electrical energy to mechanical energy quite efficiently. They foresaw that fairly simple optical to electronic circuit coupling could be achieved which would couple each element of the optical array to the corresponding element in the tactile array. [They hope to produce integrated circuitry to accomplish the necessary electronics in close cooperation with the optical and mechanical input-output aspects of the device. They should thus come up with a relatively simple, small, and useful optical-to-tactile transducer.]

[Miss M. Jameson rose several times during the afternoon sessions on June 16 to present carefully worded though spontaneous statements in favor of the optophone to counter rather strong remarks made against this system of reading. It is the belief of the writer that Miss Jameson certainly seeks the best possible system or systems for ink-print reading by the blind, but having the optophone in hand, working and producing for her and some others she has trained, she refuses to set it aside until another means convincingly does better for her.

In several visits to Miss Jameson's home after the close of the Conference for additional discussions on the optophone, she persuaded the author of these notes that forty years of practice are absolutely not necessary to achieve the level of performance she enjoys with the instrument. Under the correct conditions of motivation, capability, and good instruction she feels one should be able to achieve useful performance levels in a matter of weeks providing the instruction is quite concentrated. Miss Jameson, though specially skilled and polished in optophone use by her long years of association with the device, does not hesitate to try to learn new "codes" and seems genuinely to feel she would not have too much difficulty learning and mastering a code which was in fact an improvement over the existing one.]

WORKSHOP ON READING MACHINES

(June 16, 1966)

The Conference sessions for Thursday, June 16, were followed by a workshop on reading machines organized by Dr. M. Clowes. Drs. Clowes, F. S. Cooper, and D. Broadbent made the principal comments at the workshop. Following the workshop there was a reception period hosted by Ultra Electronics, Ltd. This gathering provided an opportunity for more informal discussion between participants and with officials of the manufacturing firm which has produced the Kay-Ultra ultrasonic aids.

REHABILITATION AND MOBILITY

(June 17, 1966)

CHAIRMAN: PROF. R. G. BOITEN
Technische Hogeschool, Delft, Netherlands

"Rehabilitation and Mobility Training and Future Developments"

E. VENN, Royal National Institute for the Blind, England

Mr. Venn said he thought there were four main points to be considered in regard to locomotion: 1. Aiding balance by giving a feedback of the body's position in relation to the terrain. 2. Protection, the avoidance of obstacles, holes, etc., and the ability to differentiate between normal surface undulation and that of hazardous proportions. 3. Determination of ground surface, that is, is it gravel, ice, water or rubble? This greatly affects the way in which the foot is put down, whether a full stride is taken, and which muscles may be required most. 4. Directional guidance by using "landmarks" as aids to navigation, a method the sighted pedestrian uses to keep a straight line or to follow a path. Even though there may be many obstacles to deflect him, he is able to "home in" on any desired point.

Mr. Venn then went on to explain how he had studied mobility means throughout the world, finding that the long cane had been widely accepted in a number of countries and was producing very useful results for the blind. He felt it could be made even more acceptable to the British blind if it somehow could be really made collapsible to fit into a pocket or purse when not in use. Engineering work was done at the Royal National Institute for the Blind and the designers came up with a cane made of a number of very small segments which are forced together to form a rigid cane, by use of a central tensioning cable. When collapsed the cane can be "folded" into a small circular packet which fits the pocket or purse rather comfortably. Mr. Venn said that he feels it wise to pursue development and introduction of such canes while at the same time always holding firm in the belief that some day technologists will come forward with an acceptable and practical device to increase further the mobility of the blind.

SENSORY EVALUATIONS AND RESEARCHES IN THE U.S.A.
(June 17, 1966)

CHAIRMAN: PROF. R. G. BOITEN
Technische Hogeschool, Delft, Netherlands

"Determination of Performance Attainable with the Battelle Optophone"

DR. L. H. RILEY, ACRIBAR, U.S.A.

Dr. Riley described a research project sponsored by the Veterans Administration at the American Center for Research in Blindness and Rehabilitation on the determination of performance attainable with the Battelle optophone. Three optophone instruments were made available to ACRIBAR and students were selected to be put through the training program which had been developed at Battelle. Personal matters such as illness, obtaining work, or transferring on the job to another city made it very difficult to maintain sustained subject participation in the program. The reading rates of the best subject in the first seven tests, these tests coming after each successive 10-hours of instruction, were respectively 2, 4, 3.1, 3.5, 4.8, 5 and 5.5 words per minute. It should be noted that merely counting the number of words per minute omits information about the important factor — comprehension of the material being read. The two best performers on the device had a number of suggestions for improvement involving having a more sophisticated tracking device which would reduce the number of manual operations necessary and which would provide for a smoother and more constant tracking operation. They also thought drill on recognition of individual letters, more frequent training periods with longer class time, and more meaningful content in lesson materials would improve the program. Some trials were also conducted at ACRIBAR with the Visotoner developed at Mauch Laboratories. Dr. Riley's conclusion here was that the Visotoner and Colineator were positive and progressive developments in the field of reading devices for the blind.

"Research in Sensory Aids for the Blind"

H. FREIBERGER, Veterans Administration, U.S.A.

Mr. Freiberger (the author of this article) mentioned the legal basis for the involvement of the Veterans Administration in research in prosthetics and sensory aids, and then went on to tell of some of the functions of this agency in sensory aids research. He mentioned the information dissemination activities of the Research and Development Division based in New York, told of its work with the optophone, and of the more recent developments at Mauch Laboratories under contract to the Veterans Administration. He briefly mentioned the speech-research work at Haskins Laboratories in New York and developments at Metfessel Laboratories in Cali-

fornia with spelled-speech. Psycho-acoustic research done under Veterans Administration contract at Lockheed-California Company was also mentioned. Professor Benham's work at Haverford College and Bionic Instruments, Inc., leading to the development of the Model G-5 Obstacle Detector as reported elsewhere in the Conference and the subsequent evaluation of this device at TRACOR, Inc., were also summarized. Finally, Mr. Freiburger alluded to the VA-sponsored work reported by Dr. Riley at this Conference on the evaluation of 14 of the Kay-Ultra ultrasonic mobility aids purchased from Ultra Electronics, Ltd.

"The Role of the Subcommittee on Sensory Aids of the Committee on Prosthetics Research and Development of the National Academy of Sciences — National Research Council"

PROF. R. W. MANN, Massachusetts Institute of Technology, U.S.A.

Professor Mann outlined the magnitude of the problems in sensory aids research for the blind and gave the history of the development of the present sensory aids subcommittee he chairs and which had been formed to help in the solution of these problems. He also briefly outlined the history of sensory aids research at the Massachusetts Institute of Technology, and then told particularly about the work currently being undertaken at MIT in his own unit.

PANEL DISCUSSION AND ADJOURNMENT

(June 17, 1966)

Friday afternoon, June 17th, was devoted to a panel presentation made under the chairmanship of Dr. A. M. Uttley. At this panel discussion, Dr. D. E. Broadbent called for more "market research" into the needs of blind people. He felt that it is necessary to know more precisely what the blind person needs by way of information to carry on his daily life. He also cautioned that proper human-factors engineering is essential in design of aids for the blind. Mr. J. K. Dupress made a strong plea that researchers must find out from blind people what they desire to do, that sighted or other researchers should not impute tasks for the blind, and then seek solutions. He feels there are solutions in work for the blind where no problems exist. He also expressed the need for several evaluation centers internationally based, sufficiently funded, and staffed to carry out competent evaluations of sensory aids. Professor R. W. Mann referred to the scale of things and indicated he feels the Kay-Ultra ultrasonic aids now extant, should, with continued evaluation, provide answers useful for projections to the whole blind population. He also espoused the idea we would

probably end up with a variety of reading aids ranging from the simple personal aid to read mostly what the sighted hardly think of as reading, to large data processing computer-type machines in central reading service centers. Mr. T. Cranmer came out unequivocally for prompt production of more Kay-Ultra aids for employment in blind user trials such as he has conducted. Dr. A. M. Uttley felt greater coordination of activities was required, for example, in the evaluation work on the Kay-Ultra device. Dr. M. D. Graham said he felt an organized plan was seriously needed to guide sensory aids development from the idea, through research and development engineering, production, and distribution phases. Reference was made to the fine system of this kind in Holland, and to the fragmented, independent approaches in so many other places. He favored long-term programs instead of short-term projects. Professor R. G. Boiten foresaw the publications explosion as interfering with the reading of the sighted as well as the blind and thought research should look to solve both problems at once. Mr. R. Dufton emphasized the importance of the match of the aid to the user by proper engineering and psychological designs. Dr. M. B. Clowes saw an artificiality in our categorizing of problems as in two areas, mobility and reading. He preferred to consider these both as one unified problem of pattern processing by a visual system. We should study this area, he felt. Professor R. L. Beurle made the concluding remarks lamenting the fact that all the evaluations of the Kay-Ultra ultrasonic aid had not progressed as far as had been expected. He was encouraged that so much had been learned, however. The meeting was closed with courteous references to the many persons and organizations making it possible.

The final functions of the Conference were a reception and dinner held the evening of Friday, June 17th. There was an opportunity here for all to meet the senior officers of St. Dunstan's, and the dinner speaker of the evening, Mr. Edward Redhead, M.P.

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